

Experimental and Research Station,

Nursery & Market Garden Industries'

- - Development Society, Limited. - -

Turner's Hill, Cheshunt, Herts.

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Introduction.

THE Nursery and Market Garden Industries' Development Society, Limited, continues to make steady progress. It is a pleasure to record that members of the glasshouse industry, in all parts of the country, are showing increased interest in the work of the Experimental Station and availing themselves more and more of its advisory and research facilities. Complete co-operation between the grower and the scientific worker is essential if the many problems of such economic importance to the industry are to be solved. It is hoped, therefore, that growers will take every opportunity of bringing their problems to the Station, of watching our experiments and assisting us by their criticism and suggestions.

During 1923 five new glasshouses were erected at the Station. Four of these are of the "aeroplane" type, built in block formation, each being 100 feet long, 15 feet wide and 7 feet to the gutters. The fifth is designed for special experiments. It has six chambers, each 15 feet square, with gutters 7 feet high, and a corridor 5 feet wide round three sides. The heating system has been arranged so as to allow the temperature of each chamber to be independently controlled. By varying the amount of radiation surface it is possible to keep the temperature of all the chambers at the same or different levels. The number of pipes has been arranged in such a manner that when the outside temperature is 32°F., temperatures approximating to 90°F., 82°F., 74°F., 66°F., 58°F. and 50°F. can be maintained in the respective chambers. The block of four houses is ultimately intended for the selection and breeding of new varieties of glasshouse crops, but for the present the houses are being used for experiments designed to determine the cause and prevention of the fall in yield of

the tomato crop which takes place after the first two years of cultivation under glass. This problem, which is of considerable economic importance to growers, is being studied from as many different view-points as possible, and forms part of the work of each member of the staff. The special house, at present allotted to the carbon dioxide investigation, will later be used to determine the effect of different temperatures upon growth, fruit production and resistance to disease of glasshouse crops. The cost of these houses was £1,400, half of which was granted by the Treasury on the recommendation of the Development Commissioners and the Ministry of Agriculture.

It is a pleasure to note also that, owing to the further generosity of these bodies, funds have been provided, with which it is possible to develop the chemical side of the work. In January, 1923, Mr. Owen Owen took up his duties as Chemist to the Station and some of the many chemical problems which have long demanded attention are now being studied. Mr. Owen has begun to examine the soils of some of the experimental plots, and is also paying attention to the chemical aspects of the control of diseases and pests studied in the mycological and entomological departments.

Subscriptions from members during 1923 amounted to £233 more than in 1922. Capital expenditure during 1923 included half the cost of the new houses and the cost of boring an artesian well 250 feet deep and the erection of a pumping plant. The total sum expended was £1,277 but, owing to donations from growers, it was possible to pay off £500 of this amount. Thus the capital debt at the end of 1923 was £1,019, being £778 more than it was at the end of 1922. The debt on the Maintenance Account was £714, being £175 less than that of the previous year.

The scheme of experiments in the old tomato houses has been completely revised and important results are anticipated. Annual variety trials have been started in which new varieties will be compared with well-established old ones like Ailsa Craig, Comet and Kondine Red. A new series of manurial trials was begun on the starved soil in plots from which nitrogen, phosphates and potash respectively have been withheld during seven years. Each of these plots was divided into four small plots receiving different amounts of the particular nutrient in which the soil was lacking. These experiments will be extended over a number of years and have for their object the determination of the proportions of nitrogen, phosphates and potash best suited to the tomato crop grown under our conditions. Further manurial trials were made to determine the relative values of base and top-dressing treatments. Such experiments are very necessary as a large amount of money is spent annually by growers upon base manures. In another inquiry one house was divided into a number of small plots to determine the relation between crop and position in the house.

The cucumber experiments were in continuation of those begun in 1922, and were concerned mainly with the relation of certain base treatments to crop yield and resistance to disease.

The carbon dioxide investigations commenced in 1922 are being continued by Mr. Owen and Mr. P. H. Williams, supported by a special grant from the Ministry of Agriculture. In 1924 these investigations will be continued, and by the courtesy of the manufacturers, who have loaned the necessary plant and supervised its erection at the Station, it will be possible to test commercial apparatus for supplying carbon dioxide to glasshouses on a large scale.

DIRECTOR'S REPORT.

Experimental Results of 1923.

The practice of grading the tomato fruits from the experimental plots adopted in 1921 was continued during the present season. The fruits are collected from each plot in numbered baskets and graded into seven grades as follows:—

- A.—“Pinks” number 5 to 7 and “Pink and Whites” 8 to 10 to the lb. These are the best quality of fruit in size, shape and colour; “Pinks” being slightly larger than “Pink and Whites.”
- B.—“Whites.” These are fruit of good shape and colour but smaller than “Pink and Whites.”
- C.—“Blues.” This grade consists of fruit of good colour but larger and more irregular in shape than Grade A.
- D.—“Roughs.” Small misshapen fruits about the size of cherries.
- E.—Blotchy fruits which ripen irregularly.
- F.—Fruits showing Blossom End Rot.
- G.—Fruit showing lesions of “Stripe Disease.”

Manurial Experiments with Tomatoes.

(a) Series J. and K.

These experiments which have been in progress since 1916 were revised for 1923. Manx Marvel was substituted for Comet and Kondine Red, which had been grown during six previous years in Series J. and K. respectively. Apart from this change in variety Series K. has been repeated as in previous years. Series J., however, has been completely altered. In the first instance nitrate of soda has been omitted from this series and a new complete artificial mixture arranged which, for convenience, is styled “Formula II.” in contrast to “Formula I.” the old mixture still used in Series K. It is difficult to say, at this stage, whether the omission of the nitrate of soda is beneficial or not, though it is common

knowledge that many nurserymen will not apply this compound to a tomato crop. The unmanured plot, J2, which produces a low yield, was sterilised with formaldehyde in December, 1922. The commercial liquid, 40% pure, was diluted with water at the rate of 1 gallon of the former to 49 gallons of the latter. Fifty gallons of this solution were applied to every 12 sq. yds. of soil surface after the latter had been thoroughly broken up. The saturated soil was covered with sacks for 48 hours to retain the vapours; the covering was then removed and the soil allowed to dry. The object of this treatment was to determine whether the low yield from the unmanured plot was due simply to the lack of food, or if it was caused in part by the presence of disease organisms in the soil. The results summarised in Table I. indicate a slight benefit from the sterilisation, and lend colour to the suggestion that disease organisms are operating in this plot. Unfortunately, when the roots were examined at the end of the season they were found to be infected by the fungus, *Colletotrichum tabificum*, which apparently had resisted the action of the formaldehyde treatment. This plot has now been steamed and the result will be seen at the end of the coming season.

The difference in opinion concerning the relative value of bone meal and bone flour as against that of basic slag for tomatoes seemed to indicate that a trial of these compounds was necessary. Consequently two plots, J3 and K4, were allotted to this experiment. J3 received stable manure, bone meal, bone flour, and sulphate of potash in the base, while J4 received stable manure, basic slag, sulphate of potash, and sulphate of ammonia equivalent to the amount of nitrogen in the bone meal and bone flour. Both plots were top-dressed throughout the season with sulphate of ammonia, superphosphate, and sulphate of potash. The results given in Tables I., VI. and VII. indicate that in 1923 there is little to choose between basic slag and bone meal and bone flour as a base fertiliser. If anything the advantage lies with the latter compounds, because basic slag appeared to increase the percentage of blotchy fruit.

Perhaps the most important plots in the house were J6, 7 and 8, in which an attempt was made to rebuild the unbalanced soil produced by omitting phosphates, nitrogen and potash, respectively, during the previous six years. For this purpose these plots were sub-divided into four equal sections, to each of which was added different quantities of the particular fertiliser in which the plot was deficient. Thus the plot without phosphate during seven years was divided into four equal plots, one of which was without phosphate as

before, the second had a mixture containing 8% phosphate, the third 16% and the fourth 24%. Plot 7, starved in respect of nitrogen, was divided into four plots; one was left without nitrogen, the others had $1\frac{1}{4}\%$, $2\frac{1}{2}\%$ and 5% nitrogen, respectively. Plot 8, deficient in potash, was divided into four plots; one without, the others with $2\frac{1}{2}\%$, 5% and 7% potash, respectively.

These experiments were arranged to determine what proportions of nitrogen, phosphate and potash are most suitable for the tomato on our soil. When this point has been decided it will be necessary to test the different sources of these foods with the ultimate object of preparing the most suitable tomato fertiliser. The data in Table I. show an increase of 17% as the result of applying 5% nitrogen to the nitrogen starved soil and an increase of 30% on applying 7% potash. The results from the phosphate plots are inexplicable, at present, as the addition of even 8% phosphates resulted in a decreased yield. Perhaps the most reasonable explanation is that the yield on the untreated plot, for some unknown reason, was abnormally high, so that comparison is impossible. On examining the tomato roots at the end of the season they were found to be badly infected by *Colletotrichum tabificum*, and it is probable that this fungus is vitiating the experimental results. It is unreasonable to suppose that the results of manurial experiments will be the same whether or not disease organisms are present in the soil. In order to eliminate this influence the soil in this house has been steamed preparatory to next season's work.

The best result from these experiments is the interesting relation between manurial treatment and blotchy ripening of the fruit which reduces its money value so considerably. The vital data are analysed in Table II. It will be seen that a deficiency of both nitrogen and potash in the soil, especially the latter, increases the quantity of blotchy fruit (Grade E.). It will be seen further, Table III., that the addition of both nitrogen and potash to soil deficient in these nutrients reduced the quantity of blotchy fruit.

In Series K., which has been continued as in previous years, complete artificials and complete artificials with standard produced the highest yields. The double dressing of complete artificials was clearly excessive, the yield being considerably lower than that from the single dressing. The unmanured plot and those from which nitrogen, phosphates and potash, respectively, have been continuously omitted, gave low yields. The results are summarised in Table XXI. and fully detailed in Tables XXII. to XXIX.

Table I.

Plot Number and Treatment.	Series J. Variety—"Manx Marvel."							
	Lbs. per Plant during					Total		Relative
	June	July	August	Sept.	October	Lbs. per Plant	Tons per Acre	
1. Double Complete Artificials	1.33	2.24	0.75	0.34	0.30	4.96	37.70	97
2. Unmanured, sterilised with Formaldehyde	1.12	1.93	0.54	0.44	0.30	4.33	32.91	85
3. Phosphates as Bone Meal and Bone Flour	1.70	2.52	0.89	0.20	0.33	5.64	42.86	111
4. Phosphates as Basic Slag	1.90	2.21	0.98	0.20	0.37	5.66	43.02	111
5. Complete Artificials...	1.45	2.10	0.77	0.38	0.39	5.09	38.69	100
6a. Complete Artificials without Phosphates	1.67	1.80	0.84	0.37	0.33	5.01	38.08	98
6b. 8% Phosphates ...	1.63	1.70	0.68	0.21	0.21	4.43	33.67	87
6c. 16% Phosphates ...	1.64	1.93	0.60	0.26	0.16	4.59	34.89	90
6d. 24% Phosphates ...	1.67	1.50	0.79	0.26	0.14	4.36	33.14	86
7a. Complete Artificials without Nitrogen ...	1.87	1.37	0.67	0.63	0.15	4.69	35.64	92
7b. 1½% Nitrogen	2.09	1.86	0.76	0.68	0.32	5.71	43.40	112
7c. 2½% Nitrogen	1.70	1.85	0.73	0.56	0.18	5.02	38.15	99
7d. 5% Nitrogen	1.84	2.05	0.59	0.77	0.25	5.50	41.80	108
8a. Complete Artificials without Potash ...	1.47	1.40	0.67	0.56	0.41	4.51	34.28	89
8b. 2½% Potash	1.39	1.57	0.68	0.75	0.39	4.72	35.87	93
8c. 5% Potash	1.25	1.59	0.76	0.71	0.54	4.85	36.86	95
8d. 7% Potash	2.04	1.85	0.86	0.59	0.54	5.88	44.68	115

Table II.

Plot Number and Treatment.	Percentage of Blotchy Fruits.		
	1921. Comet.	1922. Comet.	1923. Manx Marvel.
J1. Double Complete Artificials *	3.11	0	2.22
J2. Unmanured	47.18	8.64	25.17
J3. Standard and Complete Artificials ...	4.50	0.27	3.55
J6. Complete Artificials less Phosphates ...	8.75	0	1.60
J7. Complete Artificials less Nitrogen ...	27.65	0.28	10.23
J8. Complete Artificials less Potash ...	31.83	1.52	22.39
	Kondine Red.	Kondine Red.	Kondine Red.
K1. Double Complete Artificials †	1.97	0.99	1.85
K2. Unmanured	57.16	38.65	18.45
K3. Standard and Complete Artificials ...	2.77	1.90	2.28
K6. Complete Artificials less Phosphates ...	6.37	0.21	2.52
K7. Complete Artificials less Nitrogen ...	23.99	7.15	8.73
K8. Complete Artificials less Potash ...	24.23	20.15	18.35

* Complete Artificials Formula I. in 1921, 1922, and Formula II. 1923.

† Complete Artificials Formula I. in 1921, 1922 and 1923.

Table III.

Percentage of Blotchy Fruit in 1923.

Plots 6a to 6d.

Per cent. Phosphates in Fertiliser ...	0	8	16	24
Per cent. Blotchy Fruit	1.60	0.68	2.61	2.98

Plots 7a to 7d.

Per cent. Nitrogen in Fertiliser ...	0	$1\frac{1}{4}$	$2\frac{1}{2}$	5
Per cent. Blotchy Fruit	10.23	4.73	3.98	2.00

Plots 8a to 8d.

Per cent. Potash in Fertiliser ...	0	$2\frac{1}{2}$	5	$7\frac{1}{2}$
Per cent. Blotchy Fruit	22.39	12.30	12.16	14.80

Table IV.

J1. Double Complete Artificial (Formula II.)

Variety—"Manx Marvel."

Grade.	Lbs. per Plant.						Tons per Acre.	Per Cent. of Total.
	June.	July.	Aug.	Sept.	Oct.	Total.	Total.	
A.	1.20	2.02	.47	.18	.09	3.96	30.10	79.84
B.	.11	.15	.18	.11	.17	.72	5.47	14.52
C.	—	.03	.01	—	—	.04	.30	.80
D.	—	—	.04	.04	.02	.10	.76	2.02
E.	.01	.02	.05	.01	.02	.11	.84	2.22
F.	—	—	—	—	—	—	—	—
G.	.01	.02	—	—	—	.03	.23	.60
Total	1.33	2.24	.75	.34	.30	4.96	37.70	100

Table V.

J2. Unmanured and Sterilised with Formaldehyde.

Variety—"Manx Marvel."

Grade.	Lbs. per Plant.						Tons per Acre.	Per Cent. of Total.
	June.	July.	Aug.	Sept.	Oct.	Total.	Total.	
A.	.81	1.03	.16	.13	.09	2.22	16.87	51.27
B.	.06	.18	.10	.15	.17	.66	5.02	15.24
C.	—	.21	.01	.01	—	.23	1.75	5.31
D.	—	—	.01	.04	.02	.07	.53	1.62
E.	.23	.47	.26	.11	.02	1.09	8.28	25.17
F.	—	—	—	—	—	—	—	—
G.	.02	.04	—	—	—	.06	.46	1.39
Total	1.12	1.93	.54	.44	.30	4.33	32.91	100

Table VI.

J3. Phosphates as Bone Meal and Bone Flour.

Variety—"Manx Marvel."

Grade.	Lbs. per Plant.						Tons per Acre.	Per Cent. of Total.
	June.	July.	Aug.	Sept.	Oct.	Total.	Total.	
A.	1.40	2.10	.52	.08	.12	4.22	32.07	74.82
B.	.17	.29	.20	.07	.19	.92	6.99	16.31
C.	.03	.05	.01	—	—	.09	.68	1.60
D.	—	—	.03	.04	.01	.08	.61	1.42
E.	.04	.01	.13	.01	.01	.20	1.52	3.55
F.	—	—	—	—	—	—	—	—
G.	.06	.07	—	—	—	.13	.99	2.30
Total	1.70	2.52	.89	.20	.33	5.64	42.86	100

Table VII.

J4. Phosphates as Basic Slag.

Variety—"Manx Marvel."

Grade.	Lbs. per Plant.						Tons per Acre.	Per Cent. of Total.
	June.	July.	Aug.	Sept.	Oct.	Total.	Total.	
A.	1.50	1.80	.40	.09	.07	3.86	29.34	68.20
B.	.19	.19	.25	.06	.25	.94	7.15	16.61
C.	.04	.14	.01	—	—	.19	1.44	3.36
D.	—	—	.04	.03	.01	.08	.61	1.41
E.	.11	.03	.27	.02	.04	.47	3.57	8.30
F.	—	—	—	—	—	—	—	—
G.	.06	.05	.01	—	—	.12	.91	2.12
Total	1.90	2.21	.98	.20	.37	5.66	43.02	100

Table VIII.

J5. Complete Artificials (Formula II.)

Variety—"Manx Marvel."

Grade.	Lbs. per Plant.						Tons per Acre	Per Cent. of Total.
	June.	July.	Aug.	Sept.	Oct.	Total.	Total.	
A.	1.32	1.82	.50	.19	.12	3.95	30.02	77.60
B.	.10	.16	.20	.14	.25	.85	6.46	16.70
C.	—	.03	—	—	—	.08	.61	1.57
D.	—	—	.02	.04	.01	.07	.53	1.58
E.	.03	.01	.05	.01	.01	.11	.84	2.16
F.	—	—	—	—	—	—	—	—
G.	—	.03	—	—	—	0.3	.23	.59
Total	1.45	2.10	.77	.38	.39	5.09	38.69	100

Table IX.

J6a. Complete Artificials (II.) without Phosphates.

Variety—"Manx Marvel."

Grade.	Lbs. per Plant.						Tons per Acre	Per Cent. of Total.
	June.	July.	Aug.	Sept.	Oct.	Total.	Total.	
A.	1.54	1.68	.61	.18	.13	4.14	31.46	82.63
B.	.09	.09	.19	.14	.19	.70	5.32	13.97
C.	—	.01	—	—	—	.01	.08	.20
D.	—	—	.01	.05	.01	.07	.53	1.40
E.	.04	.01	.03	—	—	.08	.61	1.60
F.	—	—	—	—	—	—	—	—
G.	—	.01	—	—	—	.01	.08	.20
Total	1.67	1.80	.84	.37	.33	5.01	38.08	100

Table X.

J6b. 8% Phosphates.

Variety—"Manx Marvel."

Grade.	Lbs. per Plant.						Tons per Acre.	Per Cent. of Total.
	June.	July.	Aug.	Sept.	Oct.	Total.	Total.	
A.	1.51	1.54	.40	.12	.03	3.60	27.35	81.26
B.	.12	.09	.23	.06	.16	.66	5.02	14.90
C.	—	.03	—	—	—	.03	.23	.68
D.	—	—	.03	.03	.02	.08	.61	1.80
E.	—	.01	.02	—	—	.03	.23	.68
F.	—	—	—	—	—	—	—	—
G.	—	.03	—	—	—	.03	.23	.68
Total	1.63	1.70	.68	.21	.21	4.43	33.67	100

Table XI.

J6c. 16% Phosphates.

Variety—"Manx Marvel."

Grade.	Lbs. per Plant.						Tons per Acre.	Per Cent. of Total.
	June.	July.	Aug.	Sept.	Oct.	Total.	Total.	
A.	1.49	1.76	.33	.10	.07	3.75	28.50	81.70
B.	.12	.13	.20	.11	.05	.61	4.64	13.28
C.	—	.01	—	—	—	.01	.08	.22
D.	—	.01	—	.04	.04	.09	.68	1.97
E.	.03	.01	.07	.01	—	.12	.91	2.61
F.	—	—	—	—	—	—	—	—
G.	—	.01	—	—	—	.01	.08	.22
Total	1.64	1.93	.60	.26	.16	4.59	34.89	100

Table XII.

J6d. 24% Phosphates.

Variety—"Manx Marvel."

Grade.	Lbs. per Plant.						Tons per Acre.	Per Cent. of Total.
	June	July.	Aug.	Sept.	Oct.	Total.	Total.	
A.	1.55	1.40	.41	.09	.05	3.50	26.60	80.28
B.	.11	.08	.24	.10	.07	.60	4.56	13.76
C.	—	.01	—	.01	—	.02	.15	.46
D.	—	—	.02	.06	.02	.10	.76	2.29
E.	.01	.01	.11	—	—	.13	.99	2.98
F.	—	—	—	—	—	—	—	—
G.	—	—	.01	—	—	.01	.08	.23
Total	1.67	1.50	.79	.26	.14	4.36	33.14	100

Table XIII.

J7a. Complete Artificial (II.) without Nitrogen.

Variety—"Manx Marvel."

Grade.	Lbs. per Plant.						Tons per Acre.	Per Cent. of Total.
	June.	July.	Aug.	Sept.	Oct.	Total.	Total.	
A.	1.53	1.06	.30	.30	.03	3.22	24.47	68.66
B.	.18	.23	.14	.25	.07	.87	6.61	18.55
C.	—	.01	—	—	—	.01	.08	.21
D.	—	—	.01	.02	.04	.07	.53	1.49
E.	.14	.06	.21	.06	.01	.48	3.65	10.23
F.	.02	—	—	—	—	.02	.15	.43
G.	—	.01	.01	—	—	.02	.15	.43
Total	1.87	1.37	.67	.63	.15	4.69	35.64	100

Table XIV.

J7b. 1½% Nitrogen.

Variety—"Manx Marvel."

Grade.	Lbs. per Plant.						Tons per Acre.	Per Cent. of Total.
	June.	July.	Aug.	Sept.	Oct.	Total.	Total.	
A.	1.80	1.57	.46	.36	.06	4.25	32.30	74.43
B.	.16	.18	.23	.25	.19	1.01	7.68	17.69
C.	.01	.01	.01	—	—	.03	.23	.52
D.	—	—	.03	.04	.06	.13	.99	2.28
E.	.12	.10	.03	.01	.01	.27	2.05	4.73
F.	—	—	—	.02	—	.02	.15	.35
G.	—	—	—	—	—	—	—	—
Total	2.09	1.86	.76	.68	.32	5.71	43.40	100

Table XV.

J7c. 2½% Nitrogen.

Variety—"Manx Marvel."

Grade.	Lbs. per Plant.						Tons per Acre.	Per Cent. of Total.
	June.	July.	Aug.	Sept.	Oct.	Total.	Total.	
A.	1.52	1.54	.47	.21	.05	3.79	28.80	75.50
B.	.11	.22	.22	.28	.09	.92	6.99	18.33
C.	—	—	—	.01	—	.01	.08	.20
D.	—	—	.01	.04	.04	.09	.68	1.79
E.	.07	.08	.03	.02	—	.20	1.52	3.98
F.	—	—	—	—	—	—	—	—
G.	—	.01	—	—	—	.01	.08	.20
Total	1.70	1.85	.73	.56	.18	5.02	38.15	100

Table XVI.

J7d. 5% Nitrogen.

Variety—"Manx Marvel."

Grade.	Lbs. per Plant.						Tons per Acre.	Per Cent. of Total.
	June	July.	Aug.	Sept.	Oct.	Total.	Total.	
A.	1.66	1.68	.42	.52	.03	4.31	32.75	78.36
B.	.08	.28	.16	.21	.18	.91	6.92	16.55
C.	.01	.08	—	.01	—	.10	.76	1.82
D.	—	—	.01	.03	.03	.07	.53	1.27
E.	.09	.01	—	—	.01	.11	.84	2.00
F.	—	—	—	—	—	—	—	—
G.	—	—	—	—	—	—	—	—
Total	1.84	2.05	.59	.77	.25	5.50	41.80	100

Table XVII.

J8a. Complete Artificial (II.) without Potash.

Variety—"Manx Marvel."

Grade.	Lbs. per Plant.						Tons per Acre.	Per Cent. of Total.
	June.	July.	Aug.	Sept.	Oct.	Total.	Total.	
A.	1.06	.74	.32	.26	.17	2.55	19.38	56.54
B.	.12	.17	.13	.13	.16	.71	5.40	15.74
C.	.01	.01	—	—	—	.02	.15	.44
D.	—	—	.01	.04	.07	.12	.91	2.67
E.	.28	.40	.19	.13	.01	1.01	7.68	22.39
F.	—	—	—	—	—	—	—	—
G.	—	.08	.02	—	—	.10	.76	2.22
Total	1.47	1.40	.67	.56	.41	4.51	34.28	100

Table XVIII.

J8b.

2½% Potash.

Variety—"Manx Marvel."

Grade.	Lbs. per Plant.						Tons per Acre	Per Cent. of Total.
	June.	July.	Aug.	Sept.	Oct.	Total.	Total.	
A.	1.04	1.06	.37	.41	.20	3.08	23.41	65.25
B.	.11	.19	.22	.23	.15	.90	6.84	19.07
C.	—	.04	—	—	—	.04	.30	.85
D.	—	—	.01	.06	.04	.11	.84	2.33
E.	.24	.22	.08	.05	—	.59	4.48	12.50
F.	—	—	—	—	—	—	—	—
G.	—	—	—	—	—	—	—	—
Total	1.39	1.51	.68	.75	.39	4.72	35.87	100

Table XIX.

J8c.

5% Potash.

Variety—"Manx Marvel."

Grade.	Lbs. per Plant.						Tons per Acre	Per Cent. of Total.
	June.	July.	Aug.	Sept.	Oct.	Total.	Total.	
A.	.90	.97	.56	.43	.17	3.02	22.95	62.27
B.	.08	.13	.17	.19	.34	.91	6.92	18.76
C.	.01	.17	—	—	—	.18	1.57	3.71
D.	—	—	.01	.07	.02	.10	.76	2.06
E.	.25	.28	.02	.03	.01	.59	4.48	12.16
F.	—	—	—	—	—	—	—	—
G.	.01	.04	—	—	—	.05	.38	1.04
Total	1.25	1.59	.76	.71	.54	4.85	36.86	100

Table XX.

J8d. 7½% Potash. Variety—"Manx Marvel."

Grade.	Lbs. per Plant.						Tons per Acre.	Per Cent. of Total.
	June.	July.	Aug.	Sept.	Oct.	Total.	Total.	
A.	1.11	1.07	.64	.35	.15	3.32	25.23	56.46
B.	.48	.12	.15	.17	.31	1.23	9.35	20.92
C.	—	.28	.01	—	.01	.30	2.28	5.10
D.	—	.01	.01	.05	.07	.14	1.06	2.38
E.	.44	.37	.04	.02	—	.87	6.61	14.80
F.	—	—	—	—	—	—	—	—
G.	.01	—	.01	—	—	.02	.15	.34
Total	2.04	1.85	.86	.59	.54	5.88	44.68	100

Table XXI.

Plot Number and Treatment.	Series K. Variety—"Manx Marvel."								
	Lbs. per Plant during					Total		Relative	
	June	July	August	Sept.	October	Lbs. per Plant	Tons per Acre		
1. Double Complete Artificials	1.44	1.73	0.54	0.31	0.30	4.32	32.83	80	
2. Unmanured	0.95	1.23	0.65	0.32	0.21	3.36	25.54	62	
3. Standard treatment plus Complete Artificials ...	2.25	1.85	0.66	0.21	0.30	5.27	40.05	98	
4. Complete Artificials plus dung	1.99	1.64	0.80	0.33	0.22	4.98	38.85	95	
5. Complete Artificials ...	1.99	1.72	0.95	0.38	0.36	5.40	41.03	100	
6. Complete Artificials less Phosphates ...	1.76	1.51	0.98	0.40	0.12	4.77	36.25	88	
7. Complete Artificials less Nitrogen	1.99	1.34	0.71	0.38	0.28	4.70	35.72	87	
8. Complete Artificials less Potash	2.02	1.41	0.71	0.42	0.13	4.69	35.65	87	

Table XXII.

K1. Double Complete Artificials.

Variety—"Manx Marvel."

Grade.	Lbs. per Plant.						Tons per Acre.	Per Cent. of Total.
	June.	July.	Aug.	Sept.	Oct.	Total.	Total.	
A.	.86	1.38	.31	.15	.10	2.80	21.28	64.81
B.	.47	.24	.14	.10	.17	1.12	8.51	25.93
C.	—	.01	.01	—	—	.02	.15	.46
D.	—	.01	.03	.02	.02	.08	.61	1.85
E.	.01	.01	.02	.03	.01	.08	.61	1.85
F.	.04	—	—	—	—	.04	.30	.93
G.	.06	.08	.03	.01	—	.18	1.37	4.17
Total	1.44	1.73	.54	.31	.30	4.32	32.83	100

Table XXIII.

K2. Untreated.

Variety—"Manx Marvel."

Grade.	Lbs. per Plant.						Tons per Acre.	Per Cent. of Total.
	June.	July.	Aug.	Sept.	Oct.	Total.	Total.	
A.	.75	.88	.34	.09	.08	2.14	16.26	63.69
B.	.08	.09	.11	.11	.10	.49	3.73	14.58
C.	—	.02	—	.01	—	.03	.23	.89
D.	—	—	.01	.04	.02	.07	.53	2.09
E.	.12	.23	.19	.07	.01	.62	4.71	18.45
F.	—	—	—	—	—	—	—	—
G.	—	.01	—	—	—	.01	.08	.30
Total	.95	1.23	.65	.32	.21	3.36	25.54	100

Table XXIV.

K3. Standard Treatment and Complete Artificial.
Variety—"Manx Marvel."

Grade.	Lbs. per Plant.						Tons per Acre.	Per Cent. of Total.
	June.	July.	Aug.	Sept.	Oct.	Total.	Total.	
A.	1.70	1.47	.42	.12	.10	3.81	28.96	72.30
B.	.41	.24	.16	.07	.14	1.02	7.75	19.35
C.	.03	.02	.01	—	—	.06	.46	1.14
D.	—	—	.03	.01	.05	.09	.68	1.71
E.	.04	.03	.03	.01	.01	.12	.91	2.28
F.	—	—	—	—	—	—	—	—
G.	.07	.09	.01	—	—	.17	1.29	3.22
Total	2.25	1.85	.66	.21	.30	5.27	40.05	100

Table XXV.

K4. Complete Artificial plus Dung.
Variety—"Manx Marvel."

Grade.	Lbs. per Plant.						Tons per Acre.	Per Cent. of Total.
	June.	July.	Aug.	Sept.	Oct.	Total.	Total.	
A.	1.43	1.42	.48	.17	.05	3.55	26.98	71.29
B.	.37	.12	.20	.11	.14	.94	7.14	18.88
C.	.03	.02	—	.01	—	.06	.46	1.20
D.	—	.01	.06	.03	.02	.12	.91	2.40
E.	.04	.01	.03	.01	.01	.10	.76	2.01
F.	.01	—	—	—	—	.01	.08	.20
G.	.11	.06	.03	—	—	.20	1.52	4.02
Total	1.99	1.64	.80	.33	.22	4.98	37.85	100

Table XXVI.

K5. Complete Artificial.

Variety "Manx Marvel."

Grade.	Lbs. per Plant.						Tons per Acre.	Per Cent. of Total.
	June.	July.	Aug.	Sept.	Oct.	Total.	Total.	
A.	1.50	1.45	.67	.20	.10	3.92	29.79	72.59
B.	.42	.16	.21	.13	.19	1.11	8.45	20.56
C.	.01	.04	.01	.01	—	.07	.53	1.30
D.	—	—	.03	.03	.06	.12	.91	2.22
E.	.04	.06	.02	.01	.01	.14	1.05	2.59
F.	—	—	—	—	—	—	—	—
G.	.02	.01	.01	—	—	.04	.30	.74
Total	1.99	1.72	.95	.38	.36	5.40	41.03	100

Table XXVII.

K6. Complete Artificial less Phosphates.

Variety— "Manx Marvel."

Grade.	Lbs. per Plant.						Tons per Acre.	Per Cent. of Total.
	June.	July.	Aug.	Sept.	Oct.	Total.	Total.	
A.	1.47	1.23	.67	.22	.05	3.64	27.67	76.31
B.	.25	.16	.20	.12	.06	.79	6.00	16.56
C.	.01	.04	.01	—	—	.06	.46	1.26
D.	—	—	.06	.05	.01	.12	.91	2.52
E.	.03	.05	.03	.01	—	.12	.91	2.52
F.	—	—	—	—	—	—	—	—
G.	—	.03	.01	—	—	.04	.30	.83
Total	1.76	1.51	.98	.40	.12	4.77	36.25	100

Table XXVIII.

K7. Complete Artificial less Nitrogen.

Variety—"Manx Marvel."

Grade.	Lbs. per Plant.						Tons per Acre.	Per Cent. of Total.
	June.	July.	Aug.	Sept.	Oct.	Total.	Total.	
A.	1.31	.88	.43	.23	.10	2.95	22.42	62.77
B.	.52	.19	.18	.10	.13	1.12	8.51	23.83
C.	.01	.06	.02	—	—	.09	.68	1.91
D.	—	—	.03	.03	.02	.08	.61	1.70
E.	.14	.17	.05	.02	.03	.41	3.12	8.73
F.	—	—	—	—	—	—	—	—
G.	.01	.04	—	—	—	.05	.38	1.06
Total	1.99	1.34	.71	.38	.28	4.70	35.72	100

Table XXIX.

K8. Complete Artificial less Potash.

Variety—"Manx Marvel."

Grade.	Lbs. per Plant.						Tons per Acre.	Per Cent. of Total.
	June.	July.	Aug.	Sept.	Oct.	Total.	Total.	
A.	1.30	.55	.43	.16	.02	2.46	18.70	52.45
B.	.37	.18	.14	.11	.08	.88	6.69	18.76
C.	.05	.17	.01	.03	—	.26	1.97	5.55
D.	—	—	.03	.08	.01	.12	.91	2.56
E.	.23	.47	.09	.04	.02	.85	6.46	18.12
F.	—	.01	—	—	—	.01	.08	.21
G.	.07	.03	.01	—	—	.11	.34	2.35
Total	2.02	1.41	.71	.42	.13	4.69	35.65	100

Table XXX.
Manures applied in Series J. and K.

Plot.	TITLE.	Base Manure in Lbs. per sq. yd.						*Top-dressing in Lbs. per sq. yd.			
		Lime.	Stable Manure.	Basic Slag.	Bone Meal.	Bone Flour.	Ground Hoofs.	Sulphate of Potash.	Sulphate of Ammonia.	Nitrate of Soda.	Sulphate of Potash.
J1	Double Complete Artificials (Formula II.)	...	...	...	...	...	...	...	...	...	...
J2	Unmanured	1.0	—	0.8	—	—	—	0.2	0.8	—	0.6
J3	Phosphates as Bone Meal and Bone Flour	1.0	14	—	—	—	—	0.25	—	—	—
J4	Complete Artificials (I.)	1.0	14	1.46	0.25	0.25	—	0.25	0.4	0.4	0.3
J5	Complete Artificials (II.)	1.0	—	0.4	—	—	—	0.1	0.4	—	0.3
J6a	Complete Artificials (II.) without Phosphates	1.0	—	—	—	—	—	0.1	0.4	—	0.3
6b	Complete Artificials (II.) with 8% Phosphates	1.0	—	—	—	—	—	0.1	0.4	—	0.3
6c	Complete Artificials (II.) with 16% Phosphates	1.0	—	—	—	—	—	0.1	0.4	—	0.3
6d	Complete Artificials (II.) with 24% Phosphates	1.0	—	—	—	—	—	0.1	0.4	—	0.3
J7a	Complete Artificials (II.) without Nitrogen	1.0	—	—	—	—	—	0.1	0.4	—	0.3
7b	Complete Artificials (II.) with 1% Nitrogen	1.0	—	—	—	—	—	0.1	0.4	—	0.3
7c	Complete Artificials (II.) with 2% Nitrogen	1.0	—	—	—	—	—	0.1	0.4	—	0.3
7d	Complete Artificials (II.) with 5% Nitrogen	1.0	—	0.4	—	—	—	0.1	0.4	—	0.3
J8a	Complete Artificials (II.) without Potash	1.0	—	0.4	—	—	—	0.1	0.4	—	0.3
8b	Complete Artificials (II.) with 2% Potash	1.0	—	0.4	—	—	—	0.1	0.4	—	0.3
8c	Complete Artificials (II.) with 5% Potash	1.0	—	0.4	—	—	—	0.1	0.4	—	0.3
8d	Complete Artificials (II.) with 7½% Potash	1.0	—	0.4	—	—	—	0.1	0.4	—	0.3
K1	Double Complete Artificials (Formula I.)	...	...	...	...	...	...	...	...	...	...
K2	Unmanured	1.0	—	0.8	—	—	—	0.2	0.4	0.4	0.4
K3	Complete Artificials (I.) with Standard	1.0	14	—	—	—	—	—	—	—	—
K4	Complete Artificials (I.) with Dung	1.0	7	0.4	0.5	0.5	0.5	0.6	0.2	0.2	0.2
K5	Complete Artificials (I.)	1.0	—	0.4	—	—	—	0.1	0.2	0.2	0.2
K6	Complete Artificials (I.) without Phosphates	1.0	—	0.4	—	—	—	0.1	0.2	0.2	0.2
K7	Complete Artificials (I.) without Nitrogen	1.0	—	0.4	—	—	—	0.1	0.2	0.2	0.2
K8	Complete Artificials (I.) without Potash	1.0	—	0.4	—	—	—	0.1	0.2	0.2	0.2

* The top-dressing is applied in eight equal instalments.

(b) Top-Dressing versus Base-Dressing.

A new set of experiments was commenced in House 2, Series H, to determine the relative values of base and top-dressing treatments. Two plots were given base treatment; two were top-dressed; the third pair received both base and top-dressings. The results (Tables XXXI.—XXXVI.) are not conclusive, partially because of the abnormally high yield of 50 tons per acre obtained from one plot, H5; they are instructive in so far that the plots receiving both base and top-dressings show no definitely greater yield as the result of the extra amount of fertilisers applied. These experiments will be continued next season.

Table XXXI.**H1. Top-dressing only.****Variety—"Manx Marvel."**

Grade.	Lbs. per Plant.						Tons per Acre.	Per Cent. of Total.
	June.	July.	Aug.	Sept.	Oct.	Total.	Total.	
A.	1.20	2.05	.29	.29	.09	3.92	29.80	72.35
B.	.28	.31	.15	.26	.08	1.08	8.21	19.93
C.	.11	—	.01	.02	—	.14	1.06	2.57
D.	—	.01	.05	.12	.01	.19	1.44	3.50
E.	.03	.01	.01	.01	—	.06	.45	1.09
F.	—	—	—	—	—	—	—	—
G.	—	.02	—	—	.01	.03	.23	.56
Total	1.62	2.40	.51	.70	.19	5.42	41.19	100

Table XXXII.

H2. Base-dressing only.

Variety—"Manx Marvel."

Grade.	Lbs. per Plant.						Tons per Acre.	Per Cent. of Total.
	June.	July.	Aug.	Sept.	Oct.	Total.	Total.	
A.	1.00	2.07	.41	.44	.04	3.96	30.10	70.08
B.	.30	.42	.20	.31	.05	1.28	9.74	22.68
C.	.06	.01	.01	.03	—	.11	.84	1.96
D.	.01	.02	.04	.09	—	.16	1.22	2.84
E.	.04	.02	.03	—	—	.09	.68	1.58
F.	.01	—	—	—	—	.01	.07	.16
G.	.02	.01	.01	—	—	.04	.30	.70
Total	1.44	2.55	.70	.87	.09	5.65	42.95	100

Table XXXIII.

H3. Base and Top-dressing.

Variety—"Manx Marvel."

Grade.	Lbs. per Plant.						Tons per Acre.	Per Cent. of Total.
	June.	July.	Aug.	Sept.	Oct.	Total.	Total.	
A.	1.08	2.07	.32	.43	.07	3.97	30.16	70.26
B.	.19	.27	.14	.32	.14	1.06	8.06	18.77
C.	.06	.08	—	.08	—	.22	1.67	3.89
D.	—	.01	.06	.13	.03	.23	1.75	4.07
E.	.04	.01	—	—	—	.05	.38	.89
F.	—	—	—	—	—	—	—	—
G.	.06	.06	—	—	—	.12	.91	2.12
Total	1.43	2.50	.52	.96	.24	5.65	42.93	100

Table XXXIV.

H4. Top-dressing only.

Variety—"Manx Marvel."

Grade.	Lbs. per Plant.						Tons per Acre.	Per Cent. of Total.
	June.	July.	Aug.	Sept.	Oct.	Total.	Total.	
A.	1.27	2.30	.37	.45	.07	4.46	33.88	77.81
B.	.12	.24	.15	.24	.09	.84	6.38	14.66
C.	.03	.04	.02	.04	—	.13	.99	2.27
D.	—	—	.04	.11	.01	.16	1.22	2.80
E.	.01	.01	.01	—	—	.03	.23	.53
F.	—	—	—	—	—	—	—	—
G.	.05	.06	—	—	—	.11	.84	1.93
Total	1.48	2.65	.59	.84	.17	5.73	43.54	100

Table XXXV.

H5. Base-dressing only.

Variety—"Manx Marvel."

Grade.	Lbs. per Plant.						Tons per Acre.	Per Cent. of Total.
	June.	July.	Aug.	Sept.	Oct.	Total.	Total.	
A.	1.40	2.82	.36	.47	.07	5.12	38.89	77.57
B.	.13	.28	.18	.24	.12	1.00	7.60	15.17
C.	.06	.05	.01	.05	—	.17	1.29	2.57
D.	—	—	.06	.10	.01	.17	1.29	2.57
E.	.03	—	.01	.01	—	.05	.38	.76
F.	—	—	—	—	—	—	—	—
G.	.06	.02	—	.01	—	.09	.68	1.36
Total	1.73	3.17	.62	.88	.20	6.60	50.13	100

Table XXXVI.

H6. Base and Top-dressing.**Variety—"Manx Marvel."**

Grade.	Lbs. per Plant.						Tons per Acre.	Per Cent. of Total.
	June.	July.	Aug.	Sept.	Oct.	Total.	Total.	
A.	1.36	2.30	.31	.34	.11	4.42	33.59	73.19
B.	.29	.37	.16	.21	.11	1.14	8.67	18.89
C.	.08	.01	.01	.06	—	.16	1.21	2.64
D.	—	.01	.06	.07	.03	.17	1.29	2.81
E.	.04	—	.01	.01	.01	.07	.53	1.16
F.	—	—	—	—	—	—	—	—
G.	.03	.05	—	—	—	.08	.61	1.31
Total	1.80	2.74	.55	.69	.26	6.04	45.90	100

Manurial Treatment of Series H.**Base Manure.** (H2, H3, H5, and H6):—

1 lb. Lime per sq. yd.

No Stable Manure.

 $\frac{3}{4}$ lb. per sq. yd. of the following mixture:—

1 part Bone Meal.

1 part Bone Flour.

1 part Hoof and Horn.

1 part Sulphate of Potash.

Top-Dressing. (H1, H3, H4, and H6):—

Mulch of Stable Manure.

Eight dressings, each consisting of 2 ozs. per sq. yd. of the following mixture:—

6 parts Meat Meal.

8 parts Dissolved Bones.

3 parts Sulphate of Potash.

2 parts Bone Meal.

1 part Sulphate of Ammonia.

This gave 5% Ammonia, 24% Total Phosphates, 12% Soluble Phosphates and 7% Potash on examination.

(2) Effect of Position in the House.

This problem was investigated during the early days of the Station and definite results obtained with regard to the yield from longitudinally planted rows. When the yields from the rows were plotted on a curve this curve was characterised by a number of apices and depressions corresponding to the number of rows. Thus the highest yield was obtained from the row adjacent to the path. The next row showed a low yield, the next a high yield, but not so high as the path row, the next row a low yield and so on.

This left the problem undecided as to the effect of position in the house upon the yield from a number of small plots scattered over the house, and during 1923 an attempt was made to elucidate this side of the problem.

House 1, Series G, was divided into 34 small plots as in Fig. 1. The manurial and other treatments were as uniform as possible, and the yield from each plot was carefully recorded. It will be seen from Table XXXVII. that a considerable variation in yield was obtained from the different plots, and that this variation was quite irregular. The results have been examined by Mr. R. A. Fisher, chief statistician to Rothamsted Experimental Station, who concluded that if plots of this size be taken in sets of eight and the average yield considered, a difference greater than 5% may be regarded as significant.

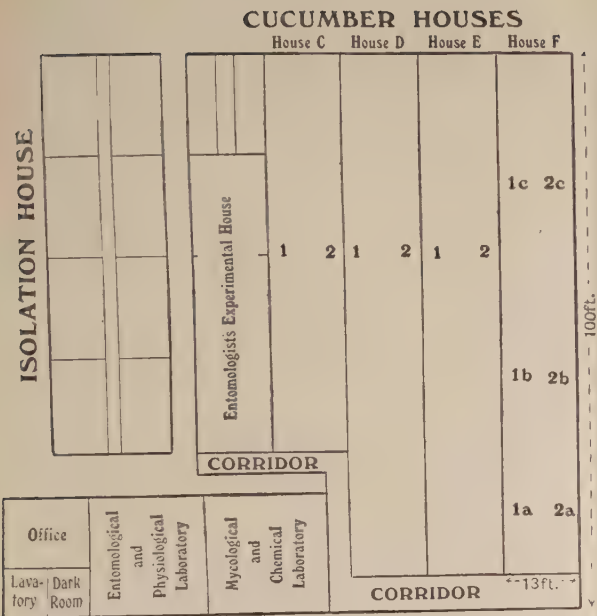


DIAGRAM
to show arrangement
of Experimental Plots
for 1923.

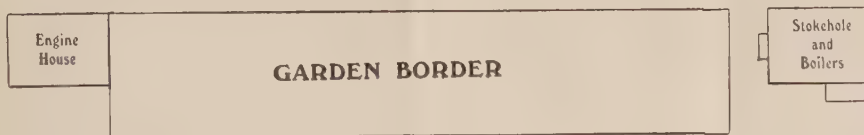
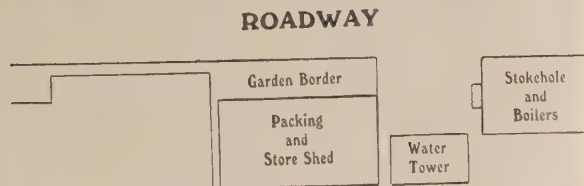
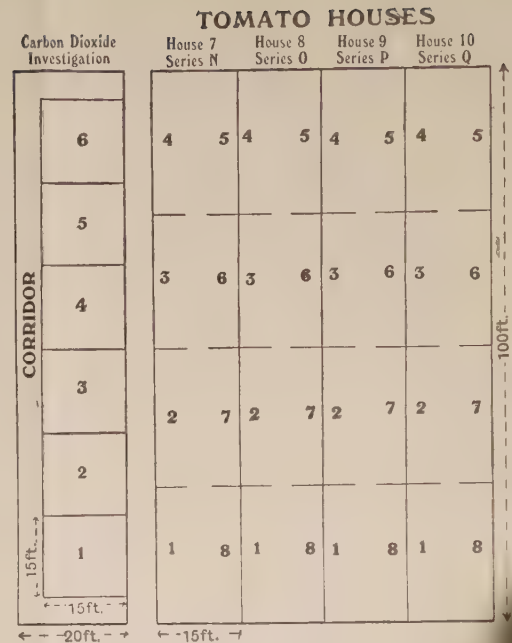
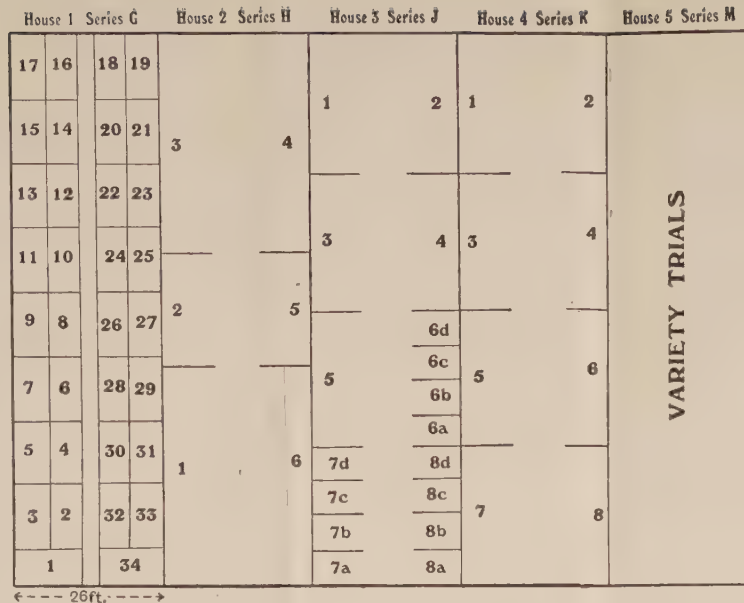


Fig. 1 S

17	16		18	19
15	14		20	21
13	12		22	23
11	10		24	25
9	8		26	27
7	6		28	29
5	4		30	31
3	2		32	33
1			34	

N

Table XXXVII.

Series G.

Plot No.	Lbs. per Plant.	Tons per Acre.
1	5.18	39.36
2	5.24	39.33
3	5.80	40.07
4	5.84	44.38
5	5.62	42.71
6	5.36	40.72
7	4.82	36.63
8	5.74	43.61
9	5.54	41.99
10	4.69	35.62
11	5.37	40.83
12	5.72	43.49
13	5.22	39.69
14	6.14	46.66
15	6.55	49.79
16	6.24	47.43
17	6.45	49.02
18	6.23	47.43
19	6.06	46.05
20	5.54	42.11
21	5.95	45.21
22	5.86	44.51
23	5.68	43.20
24	6.07	46.26
25	5.70	43.38
26	5.48	41.68
27	5.24	39.82
28	5.45	41.41
29	5.95	45.21
30	5.65	42.90
31	5.69	43.20
32	5.49	41.71
33	5.37	40.73
34	6.06	45.97

Each plot (11 ft. 4 ins. by 6 ft. 6 ins. contained 30 plants.

Manurial Treatment of Series G.

Base Manure.

- 1 lb. Lime per sq. yd.
- 14 lbs. Stable Manure per sq. yd.
- $\frac{3}{4}$ lb. per sq. yd. of the following mixture :—
 - 1 part Bone Meal.
 - 1 part Bone Flour.
 - 1 part Hoof and Horn.
 - 1 part Sulphate of Potash.

Top-dressing.

Mulch of Stable Manure.

Eight dressings, each consisting of 2 ozs. per sq. yd. of the following mixture :—

- 6 parts Meat Meal.
- 8 parts Dissolved Bones.
- 3 parts Sulphate of Potash.
- 2 parts Bone Meal.
- 1 part Sulphate of Ammonia.

This gave 5% Ammonia, 24% Total Phosphates, 12% Soluble Phosphates and 7% Potash on examination.

(3) Variety Trials.

House 5, Series M, has been allotted to annual trials in which a limited number of new varieties will be tested alongside those that are old and well-established.

The results of the first year's trial shown in Tables XXXVIII. and XXXIX. to LII. indicate the highest yield from a Manx Marvel—Ailsa Craig cross, which fruited at the rate of 48 tons per acre. Balch's Gem was second with 40 tons, and showed heavy well-formed fruit. Ailsa Craig was third with 37 tons per acre. The apparent failure of Amwell, which produces heavy crops on other soils, emphasises the unsuitability of the Blaby varieties to the Station land, which favours the Ailsa Craig types. The results are summarised in Table XXXVIII. and shown in detail in Tables XXXIX. to LII.

**Table XXXVIII.
Variety Trials.**

Variety.						Lbs. per Plant.	Tons per Acre.
Ailsa Craig x Manx Marvel	...	...				6.40	48.64
Balch's Gem	...	...	...	...		5.25	39.90
Ailsa Craig	...	...	...	...	...	4.88	37.00
Nonsuch	...	...	...	...	...	4.69	35.64
Manx Marvel	...	...	...	...	...	4.65	35.34
Fillbasket	...	...	...	...	...	4.65	35.34
Bountiful	...	...	...	...	...	4.63	35.19
Tuckswood	...	...	...	...	...	4.42	33.39
Sunrise	...	...	...	...	...	4.30	32.69
Comet	...	...	...	...	...	4.24	32.22
Jersey Mystery	...	...	...	...	...	4.06	30.86
Amwell	...	...	...	...	...	3.79	28.80

Table XXXIX.

M1. Variety—"Balch's Gem."

Grade.	Lbs. per Plant.						Tons per Acre.	Per Cent. of Total.
	June	July.	Aug.	Sept.	Oct.	Total.	Total.	
A.	1.30	1.61	.52	.39	.05	3.87	29.41	73.71
B.	.22	.11	.11	.14	.10	.68	5.17	12.95
C.	.03	.06	.06	.02	—	.17	1.29	3.24
D.	—	—	.06	.05	.01	.12	.91	2.29
E.	.04	.03	.06	.03	—	.16	1.22	3.05
F.	—	—	—	—	—	—	—	—
G.	.16	.08	.01	—	—	.25	1.90	4.76
Total	1.75	1.89	.82	.63	.16	5.25	39.90	100

Table XL.

M2. Variety—"Buckley."

Grade.	Lbs. per Plant.						Tons per Acre.	Per Cent. of Total.
	June.	July.	Aug.	Sept.	Oct.	Total.	Total.	
A.	1.12	.93	.44	.20	.03	2.72	20.67	61.26
B.	.27	.11	.10	.16	.05	.69	5.24	15.54
C.	.09	.41	.12	—	—	.62	4.71	13.96
D.	.01	—	.03	.06	.01	.11	.84	2.48
E.	.01	.01	.07	.03	—	.12	.91	2.70
F.	.01	—	—	—	—	.01	.08	.23
G.	.11	.04	.02	—	—	.17	1.29	3.83
Total	1.62	1.50	.78	.45	.09	4.44	33.74	100

Table XII.

M3. Variety—"Manx Marvel."

Grade.	Lbs. per Plant.						Tons per Acre.	Per Cent. of Total.
	June.	July.	Aug.	Sept.	Oct.	Total.	Total.	
A.	1.04	1.55	.45	.21	.01	3.26	24.78	70.11
B.	.33	.22	.21	.22	.04	1.02	7.75	21.94
C.	.01	.01	.02	.01	—	.05	.38	1.07
D.	—	—	.06	.08	.02	.16	1.22	3.44
E.	.01	.01	.06	.01	—	.09	.68	1.93
F.	—	—	—	—	—	—	—	—
G.	.05	.01	.01	—	—	.07	.53	1.51
Total	1.44	1.80	.81	.53	.07	4.65	35.34	100

Table XLII.

M4. Variety—"Sunrise."

Grade.	Lbs. per Plant.						Tons per Acre	Per Cent. of Total.
	June.	July.	Aug.	Sept.	Oct.	Total.	Total.	
A.	.79	1.02	.36	.21	.03	2.41	18.31	56.05
B.	.43	.30	.16	.23	.06	1.18	8.97	27.44
C.	.02	.04	.01	.03	—	.10	.76	2.33
D.	—	—	.02	.06	—	.08	.61	1.86
E.	—	.02	.05	.02	—	.09	.68	2.09
F.	.01	—	—	—	—	.01	.08	.23
G.	.27	.12	.04	—	—	.43	3.27	10.00
Total	1.52	1.50	.64	.55	.09	4.30	32.69	100

Table XLIII.

M5. Variety—"Nonsuch."

Grade.	Lbs. per Plant.						Tons per Acre	Per Cent. of Total.
	June.	July.	Aug.	Sept.	Oct.	Total.	Total.	
A.	.94	1.14	.43	.21	.02	2.74	20.83	58.42
B.	.49	.23	.21	.15	.07	1.15	8.74	24.52
C.	—	.04	.04	.01	—	.09	.68	1.92
D.	—	—	.05	.06	—	.11	.84	2.35
E.	.02	.01	.03	.01	—	.07	.52	1.49
F.	—	—	—	—	—	—	—	—
G.	.39	.12	.02	—	—	.53	4.03	11.30
Total	1.84	1.54	.78	.44	.09	4.69	35.64	100

Table XLIV.

M6. Variety—"Bountiful."

Grade.	Lbs. per Plant.						Tons per Acre.	Per Cent. of Total.
	June.	July.	Aug.	Sept.	Oct.	Total.	Total.	
A.	1.14	1.29	.58	.29	.03	3.33	25.31	71.92
B.	.22	.21	.19	.19	.06	.87	6.61	18.79
C.	.02	.04	.02	.02	—	.10	.76	2.16
D.	—	—	.05	.08	—	.13	.99	2.81
E.	.01	—	.01	.03	—	.05	.38	1.08
F.	—	—	—	—	—	—	—	—
G.	.10	.02	.03	—	—	.15	1.14	3.24
Total	1.49	1.56	.88	.61	.09	4.63	35.19	100

Table XLV.

M7. Variety—"Radio."

Grade.	Lbs. per Plant.						Tons per Acre.	Per Cent. of Total.
	June.	July.	Aug.	Sept.	Oct.	Total.	Total.	
A.	.92	1.10	.51	.22	.05	2.80	21.28	63.21
B.	.37	.19	.18	.16	.05	.95	7.22	21.44
C.	.01	.07	.03	.04	—	.15	1.14	3.39
D.	—	—	.04	.07	.01	.12	.91	2.71
E.	.01	—	.02	.01	—	.04	.30	.90
F.	—	—	—	—	—	—	—	—
G.	.19	.12	.06	—	—	.37	2.81	8.35
Total	1.50	1.48	.84	.50	.11	4.43	33.66	100

Table XLVI.

M8. Variety—"Ailsa Craig."

Grade.	Lbs. per Plant.						Tons per Acre.	Per Cent. of Total.
	June.	July.	Aug.	Sept.	Oct.	Total.	Total.	
A.	1.10	1.25	.51	.18	.04	3.08	23.40	63.11
B.	.25	.14	.16	.15	.07	.77	5.85	15.78
C.	.09	.23	.07	.04	—	.43	3.27	8.81
D.	—	—	.04	.08	—	.12	.91	2.46
E.	—	.02	.03	.01	—	.06	.46	1.23
F.	.01	—	—	—	—	.01	.08	.21
G.	.28	.09	.03	—	.01	.41	3.11	8.40
Total	1.73	1.73	.84	.46	.12	4.88	37.08	100

Table XLVII.

M9. Variety—"Tuckswood."

Grade.	Lbs. per Plant.						Tons per Acre.	Per Cent. of Total.
	June.	July.	Aug.	Sept.	Oct.	Total.	Total.	
A.	.92	.97	.39	.18	.04	2.50	19.00	56.55
B.	.21	.13	.13	.20	.04	.71	5.39	16.07
C.	.06	.38	.13	.08	—	.65	4.94	14.70
D.	—	—	.03	.06	.01	.10	.76	2.26
E.	—	.01	.06	.01	—	.08	.61	1.82
F.	.01	—	—	—	—	.01	.08	.23
G.	.22	.09	.06	—	—	.37	2.81	8.37
Total	1.42	1.58	.80	.53	.09	4.42	33.59	100

Table XLVIII.

M10. Variety—"Fillbasket."

Grade.	Lbs. per Plant.						Tons per Acre.	Per Cent. of Total.
	June.	July.	Aug.	Sept.	Oct.	Total.	Total.	
A.	1.07	1.04	.45	.18	.02	2.76	20.98	59.34
B.	.31	.14	.17	.13	.07	.82	6.23	17.63
C.	.11	.33	.12	.06	—	.62	4.71	13.33
D.	—	—	.03	.05	.02	.10	.76	2.16
E.	—	.04	.05	—	—	.09	.68	1.94
F.	.01	—	—	—	—	.01	.08	.22
G.	.16	.04	.05	—	—	.25	1.90	5.38
Total	1.66	1.59	.87	.42	.11	4.65	35.34	100

Table XLIX.

M11. Variety—"Comet."

Grade.	Lbs. per Plant.						Tons per Acre.	Per Cent. of Total.
	June.	July.	Aug.	Sept.	Oct.	Total.	Total.	
A.	.87	.45	.29	.14	.03	1.78	13.33	42.00
B.	.17	.07	.11	.10	.09	.54	4.10	12.73
C.	.29	.98	.15	.10	.01	1.53	11.63	36.10
D.	—	.02	.02	.06	.01	.11	.83	2.59
E.	.03	.06	.06	—	—	.15	1.14	3.53
F.	.01	—	—	—	—	.01	.08	.23
G.	.05	.04	.02	—	.01	.12	.91	2.82
Total	1.42	1.62	.65	.40	.15	4.24	32.22	100

Table L.

M12. Variety—"Amwell."

Grade.	Lbs. per Plant.						Tons per Acre.	Per Cent. of Total.
	June.	July.	Aug.	Sept.	Oct.	Total.	Total.	
A.	.70	1.02	.28	.14	.02	2.16	16.41	57.01
B.	.34	.20	.15	.11	.07	.87	6.61	22.96
C.	.05	.07	.11	.08	—	.31	2.36	8.17
D.	—	—	.06	.13	.01	.20	1.52	5.27
E.	—	.03	.02	—	—	.05	.38	1.32
F.	—	—	—	—	—	—	—	—
G.	.12	.04	.04	—	—	.20	1.52	5.27
Total	1.21	1.36	.66	.46	.10	3.79	28.80	100

Table LI.

M13. Variety—"Ailsa Craig x Manx Marvel."

Grade.	Lbs. per Plant.						Tons per Acre.	Per Cent. of Total.
	June.	July.	Aug.	Sept.	Oct.	Total.	Total.	
A.	1.33	2.28	.47	.40	.05	4.53	34.43	70.78
B.	.24	.21	.13	.39	.13	1.10	8.36	17.19
C.	.02	.18	.03	.11	—	.34	2.58	5.31
D.	—	—	.01	.12	.01	.14	1.06	2.19
E.	.03	.01	.04	—	—	.08	.61	1.25
F.	—	—	—	—	—	—	—	—
G.	.15	.06	—	—	—	.21	1.60	3.28
Total	1.77	2.74	.68	1.02	.19	6.40	48.64	100

Table LII.

M14. Variety—"Jersey Mystery."

Grade.	Lbs. per Plant.						Tons per Acre.	Per Cent. of Total.
	June.	July.	Aug.	Sept.	Oct.	Total.	Total.	
A.	—	1.48	1.07	.36	.07	2.98	22.65	73.38
B.	—	.09	.20	.23	.19	.71	5.40	17.49
C.	—	.09	.08	.03	—	.20	1.52	4.93
D.	—	—	.04	—	.10	.14	1.06	3.45
E.	—	—	—	—	—	—	—	—
F.	—	—	—	—	—	—	—	—
G.	—	.03	—	—	—	.03	.23	. 75
Total	—	1.69	1.39	.62	.36	4.06	30.86	100

Manurial Treatment of Series M.

Base Manure.

1 lb. Lime per sq. yd.

14 lbs. Stable Manure per sq. yd.

$\frac{3}{4}$ lb. per sq. yd. of the following mixture :—

1 part Bone Meal.

1 part Bone Flour.

1 part Hoof and Horn.

1 part Sulphate of Potash.

Top-Dressing.

Mulch of Stable Manure.

Eight dressings, each consisting of 2 ozs. per sq. yd. of the following mixture :—

6 parts Meat Meal.

8 parts Dissolved Bones.

3 parts Sulphate of Potash.

2 parts Bone Meal.

1 part Sulphate of Ammonia.

This gave 5% Ammonia, 24% Total Phosphates, 12% Soluble Phosphates and 7% Potash on examination.

(4) Investigations concerned with the reduction in yield of the Tomato crop which takes place after the first two years under glass.

These investigations are being conducted in the new block of four glasshouses, each 15 ft. wide and 100 ft. long, of the "aeroplane" or "high gutter" type. An attempt is being made to determine the cause of the sudden drop in yield which takes place after the first or second years under glass, and the problem is being studied from as many view-points as possible. Chemical and micro-biological analyses form the first line of attack.

In commencing the experiment, the soil was made uniform to a depth of two feet and the turf dug in. An attempt was made to obtain a high yield during the first year; three houses being manured in what is considered by commercial growers to be the most suitable way of treating a first year crop. The soil was first limed, using 2 tons of caustic lime per acre; later on stable manure, amounting to 30 tons per acre, was applied; then, shortly before planting, $\frac{1}{4}$ lb. bone meal, $\frac{1}{4}$ lb. bone flour, and $\frac{1}{4}$ lb. sulphate of potash per sq. yd. was forked into the soil. During the growing season the plants were top-dressed, when necessary, with a mixture of 6 parts meat meal, 1 part dissolved bones, 3 parts sulphate of potash, 2 parts bone flour and 1 part sulphate of ammonia, at the rate of 2 ozs. per sq. yd. The remaining house was left untreated. Two plots were left fallow; one in the unmanured house and one in a manured house. The manured houses yielded at the rate of 55.8, 55.2 and 51 tons per acre, while the untreated house gave 32.3 tons per acre. The results are shown in Tables LIII. to LXXXI.

Table LIII.

N1. Variety—"Rochford's Improved Ailsa Craig."

Grade.	Lbs. per Plant.						Tons per Acre.	Per Cent. of Total.
	June.	July.	Aug.	Sept.	Oct.	Total.	Total.	
A.	1.26	1.03	.74	.40	.55	3.98	30.25	53.73
B.	.54	.21	.18	.06	.31	1.30	9.88	17.55
C.	.21	.70	.41	.15	.30	1.77	13.45	23.84
D.	—	—	.03	.04	.02	.09	.68	1.22
E.	.03	.04	.10	—	—	.17	1.29	2.30
F.	—	—	—	—	—	—	—	—
G.	.08	.02	—	—	—	.10	.76	1.30
Total	2.12	2.00	1.46	.65	1.18	7.41	56.31	100

Table LIV.

N2. Variety—"Rochford's Improved Ailsa Craig."

Grade.	Lbs. per Plant.						Tons per Acre.	Per Cent. of Total.
	June.	July.	Aug.	Sept.	Oct.	Total.	Total.	
A.	1.25	.82	.59	.43	.42	3.51	26.68	48.08
B.	.46	.19	.13	.07	.25	1.10	8.36	15.07
C.	.44	.91	.40	.21	.25	2.21	16.79	30.27
D.	—	—	.04	.04	.02	.10	.76	1.37
E.	.18	.07	.09	—	—	.34	2.58	4.66
F.	—	—	—	—	—	—	—	—
G.	.03	—	—	—	.01	.04	.30	.55
Total	2.36	1.99	1.25	.75	.95	7.30	55.47	100

Table LV.

N3. Variety—"Rochford's Improved Ailsa Craig."

Grade.	Lbs. per Plant.						Tons per Acre.	Per Cent. of Total.
	June.	July.	Aug.	Sept.	Oct.	Total.	Total.	
A.	1.23	.88	.62	.39	.58	3.70	28.12	46.78
B.	.41	.19	.16	.05	.31	1.12	8.51	14.17
C.	.30	1.02	.55	.30	.35	2.52	19.15	31.86
D.	—	—	.01	.02	.02	.05	.38	.64
E.	.31	.01	.11	—	—	.43	3.27	5.45
F.	—	—	—	—	—	—	—	—
G.	.06	.03	—	—	—	.09	.68	1.10
Total	2.31	2.13	1.45	.76	1.26	7.91	60.11	100

N4. Fallow Plot.

N5. Fallow Plot.

Table LVI.

N6. Variety—"Rochford's Improved Ailsa Craig."

Grade.	Lbs. per Plant.						Tons per Acre.	Per Cent. of Total.
	June.	July.	Aug.	Sept.	Oct.	Total.	Total.	
A.	1.09	.76	.69	.44	.57	3.55	26.98	46.52
B.	.42	.14	.14	.09	.30	1.09	8.29	14.29
C.	.39	1.00	.44	.19	.32	2.34	17.78	30.67
D.	—	—	.01	.04	.02	.07	.53	.93
E.	.26	.06	.13	—	—	.45	3.42	5.89
F.	—	—	—	—	—	—	—	—
G.	.11	.01	.01	—	—	.13	.99	1.70
Total	2.27	1.97	1.42	.76	1.21	7.63	57.99	100

Table LVII.

N7. Variety—"Rochford's Improved Ailsa Craig."

Grade.	Lbs. per Plant.						Tons per Acre.	Per Cent. of Total.
	June.	July.	Aug.	Sept.	Oct.	Total.	Total.	
A.	.90	.77	.60	.35	.50	3.12	23.72	44.59
B.	.52	.14	.13	.06	.32	1.17	8.89	16.71
C.	.27	.88	.59	.16	.33	2.23	16.94	31.85
D.	—	—	.02	.05	.01	.08	.61	1.14
E.	.22	.03	.08	—	—	.33	2.51	4.71
F.	—	—	—	—	—	—	—	—
G.	.06	.01	—	—	—	.07	.53	1.00
Total	1.97	1.83	1.42	.62	1.16	7.00	53.20	100

Table LVIII.

N8. Variety—"Rochford's Improved Ailsa Craig."

Grade.	Lbs. per Plant.						Tons per Acre.	Per Cent. of Total.
	June.	July.	Aug.	Sept.	Oct.	Total.	Total.	
A.	.98	.81	.71	.43	.46	3.39	25.76	49.85
B.	.47	.18	.15	.07	.23	1.10	8.36	16.17
C.	.25	.66	.55	.16	.30	1.92	14.59	28.22
D.	—	—	.03	.04	.02	.09	.68	1.31
E.	.03	.05	.05	—	—	.13	.99	1.90
F.	—	—	—	—	—	—	—	—
G.	.13	.04	—	—	—	.17	1.29	2.55
Total	1.86	1.74	1.49	.70	1.01	6.80	51.67	100

Table LIX.**01. Variety—"Rochford's Improved Ailsa Craig."**

Grade.	Lbs. per Plant.						Tons per Acre	Per Cent. of Total.
	June.	July.	Aug.	Sept.	Oct.	Total.	Total.	
A.	.97	.74	.64	.39	.52	3.26	24.77	46.50
B.	.47	.16	.13	.07	.32	1.15	8.74	16.41
C.	.26	.76	.38	.13	.33	1.86	14.14	26.54
D.	—	—	.01	.04	.02	.07	.53	.99
E.	.24	.06	.04	.04	—	.38	2.89	5.42
F.	—	—	—	—	—	—	—	—
G.	.24	.04	.01	—	—	.29	2.20	4.14
Total	2.18	1.76	1.21	.67	1.19	7.01	53.27	100

Table LX.**02. Variety—"Rochford's Improved Ailsa Craig."**

Grade.	Lbs. per Plant.						Tons per Acre	Per Cent. of Total.
	June.	July.	Aug.	Sept.	Oct.	Total.	Total.	
A.	1.04	.71	.60	.38	.43	3.16	24.02	44.27
B.	.50	.20	.13	.06	.28	1.17	8.89	16.39
C.	.32	1.05	.34	.16	.30	2.17	16.49	30.39
D.	—	.01	.01	.04	.03	.09	.68	1.25
E.	.20	.12	.05	.01	—	.38	2.89	5.32
F.	—	—	—	—	—	—	—	—
G.	.12	.05	—	—	—	.17	1.29	2.38
Total	2.18	2.14	1.13	.65	1.04	7.14	54.26	100

Table LXI.

03. Variety—"Rochford's Improved Ailsa Craig."

Grade.	Lbs. per Plant.						Tons per Acre.	Per Cent. of Total.
	June	July.	Aug.	Sept.	Oct.	Total.	Total.	
A.	.68	.55	.57	.39	.58	2.77	21.06	36.71
B.	.38	.19	.12	.05	.29	1.03	7.83	13.64
C.	.39	1.16	.55	.17	.29	2.56	19.45	33.90
D.	—	—	.02	.05	.02	.09	.68	1.19
E.	.56	.27	.11	.01	—	.95	7.22	12.58
F.	—	—	—	—	—	—	—	—
G.	.14	.01	—	—	—	.15	1.14	1.98
Total	2.15	2.18	1.37	.67	1.18	7.55	57.38	100

Table LXII.

04. Variety—"Rochford's Improved Ailsa Craig."

Grade.	Lbs. per Plant.						Tons per Acre.	Per Cent. of Total.
	June.	July.	Aug.	Sept.	Oct.	Total.	Total.	
A.	.64	.85	.53	.42	.57	3.01	22.88	39.99
B.	.32	.15	.14	.06	.30	.97	7.37	12.88
C.	.28	1.20	.39	.22	.32	2.41	18.31	32.00
D.	—	—	—	.03	.02	.05	.38	.66
E.	.45	.17	.09	—	—	.71	5.40	9.43
F.	—	—	—	—	—	—	—	—
G.	.24	.13	.01	—	—	.38	2.89	5.04
Total	1.93	2.50	1.16	.73	1.21	7.53	57.23	100

Table LXIII.

05. Variety—"Rochford's Improved Ailsa Craig."

Grade.	Lbs. per Plant.						Tons per Acre.	Per Cent. of Total.
	June.	July.	Aug.	Sept.	Oct.	Total.	Total.	
A.	.69	.82	.49	.34	.67	3.01	22.87	39.82
B.	.32	.20	.13	.07	.28	1.00	7.60	13.23
C.	.28	1.23	.52	.18	.39	2.60	19.76	34.40
D.	—	—	.03	.07	.04	.14	1.06	1.84
E.	.37	.12	.07	—	—	.56	4.26	7.40
F.	—	—	—	—	—	—	—	—
G.	.13	.12	—	—	—	.25	1.90	3.31
Total	1.79	2.49	1.24	.66	1.38	7.56	57.45	100

Table LXIV.

06. Variety—"Rochford's Improved Ailsa Craig."

Grade.	Lbs. per Plant.						Tons per Acre.	Per Cent. of Total.
	June.	July.	Aug.	Sept.	Oct.	Total.	Total.	
A.	.68	.75	.56	.43	.47	2.89	21.97	40.09
B.	.26	.22	.12	.08	.26	.94	7.14	13.04
C.	.31	1.28	.49	.18	.21	2.47	18.77	34.25
D.	—	—	.01	.06	.02	.09	.68	1.24
E.	.44	.11	.05	—	—	.60	4.56	8.32
F.	—	—	—	—	—	—	—	—
G.	.13	.08	.01	—	—	.22	1.67	3.06
Total	1.82	2.44	1.24	.75	.96	7.21	54.79	100

Table LXV.

07. Variety—"Rochford's Improved Ailsa Craig."

Grade.	Lbs. per Plant.						Tons per Acre.	Per Cent. of Total.
	June.	July.	Aug.	Sept.	Oct.	Total.	Total.	
A.	.69	.79	.53	.35	.55	2.91	22.12	38.39
B.	.30	.18	.12	.06	.34	1.00	7.60	13.18
C.	.30	1.43	.52	.17	.38	2.80	21.28	36.97
D.	—	—	.03	.04	.03	.10	.76	1.31
E.	.42	.11	.06	.01	—	.60	4.56	7.92
F.	—	—	—	—	—	—	—	—
G.	.12	.03	.02	—	—	.17	1.29	2.23
Total	1.83	2.54	1.28	.63	1.30	7.58	57.61	100

Table LXVI.

08. Variety—"Rochford's Improved Ailsa Craig."

Grade.	Lbs. per Plant.						Tons per Acre.	Per Cent. of Total.
	June.	July.	Aug.	Sept.	Oct.	Total.	Total.	
A.	.78	.88	.49	.41	.48	3.04	23.11	46.41
B.	.35	.19	.13	.08	.23	.98	7.45	14.96
C.	.21	.90	.49	.29	.27	2.07	15.70	31.61
D.	—	—	.02	.03	.02	.07	.53	1.07
E.	.17	.06	.07	—	—	.30	2.28	4.58
F.	—	—	—	—	—	—	—	—
G.	.04	.04	.01	—	—	.09	.68	1.37
Total	1.55	2.07	1.21	.72	1.90	6.55	49.75	100

Table LXVII.

P1. Variety—"Rochford's Improved Ailsa Craig."

Grade.	Lbs. per Plant.						Tons per Acre.	Per Cent. of Total.
	June.	July.	Aug.	Sept.	Oct.	Total.	Total.	
A.	.84	.98	.57	.48	.51	3.38	25.68	49.78
B.	.31	.17	.13	.07	.23	.91	6.91	13.40
C.	.15	1.01	.37	.21	.32	2.06	15.66	30.34
D.	—	—	—	.04	.03	.07	.53	1.03
E.	.09	.09	.03	.01	—	.22	1.67	3.24
F.	—	—	—	—	—	—	—	—
G.	.09	.05	.01	—	—	.15	1.14	2.21
Total	1.48	2.30	1.11	.81	1.09	6.79	51.59	100

Table LXVIII.

P2. Variety—"Rochford's Improved Ailsa Craig."

Grade.	Lbs. per Plant.						Tons per Acre.	Per Cent. of Total.
	June.	July.	Aug.	Sept.	Oct.	Total.	Total.	
A.	.63	.74	.45	.35	.45	2.64	20.04	41.00
B.	.30	.21	.13	.07	.21	.92	6.99	14.28
C.	.12	1.29	.32	.19	.19	2.11	16.03	32.76
D.	—	—	.01	.06	.02	.09	.68	1.40
E.	.25	.15	.04	.01	—	.45	3.42	6.99
F.	—	—	—	—	—	—	—	—
G.	.11	.11	.01	—	—	.23	1.75	3.57
Total	1.41	2.52	.96	.68	.87	6.44	48.91	100

Table LXIX.

P3. Variety—"Rochford's Improved Ailsa Craig."

Grade.	Lbs. per Plant.						Tons per Acre.	Per Cent. of Total.
	June.	July.	Aug.	Sept.	Oct.	Total.	Total.	
A.	.59	.92	.53	.41	.39	2.84	21.58	47.18
B.	.29	.21	.13	.09	.22	.94	7.14	15.62
C.	.08	.89	.37	.16	.20	1.70	12.92	28.23
D.	—	—	.02	.04	.02	.08	.61	1.33
E.	.18	.06	.07	—	—	.31	2.36	5.15
F.	—	—	—	—	—	—	—	—
G.	.05	.09	.01	—	—	.15	1.14	2.49
Total	1.19	2.17	1.13	.70	.83	6.02	45.75	100

Table LXX.

P4. Variety—"Rochford's Improved Ailsa Craig."

Grade.	Lbs. per Plant.						Tons per Acre.	Per Cent. of Total.
	June.	July.	Aug.	Sept.	Oct.	Total.	Total.	
A.	.66	.84	.54	.44	.49	2.97	22.56	43.04
B.	.30	.24	.13	.06	.30	1.03	7.83	14.94
C.	.24	1.23	.39	.20	.20	2.26	17.18	32.77
D.	—	—	.03	.05	.02	.10	.76	1.44
E.	.25	.11	.10	—	—	.46	3.49	6.65
F.	—	—	—	—	—	—	—	—
G.	.03	.05	—	—	—	.08	.61	1.16
Total	1.48	2.47	1.19	.75	1.01	6.90	52.43	100

Table LXXI.

P5. Variety—"Rochford's Improved Ailsa Craig."

Grade.	Lbs. per Plant.						Tons per Acre.	Per Cent. of Total.
	June.	July.	Aug.	Sept.	Oct.	Total.	Total.	
A.	.69	1.02	.48	.46	.58	3.23	24.55	42.57
B.	.33	.23	.15	.09	.28	1.08	8.21	14.23
C.	.20	1.43	.50	.23	.30	2.66	20.21	35.04
D.	—	—	.02	.04	.01	.07	.53	.91
E.	.22	.13	.09	—	—	.44	3.34	5.79
F.	—	—	—	—	—	—	—	—
G.	.06	.04	.01	—	—	.11	.84	1.46
Total	1.50	2.85	1.25	.82	1.17	7.59	57.68	100

Table LXXII.

P6. Variety—"Rochford's Improved Ailsa Craig."

Grade.	Lbs. per Plant.						Tons per Acre.	Per Cent. of Total.
	June.	July.	Aug.	Sept.	Oct.	Total.	Total.	
A.	.64	.69	.44	.44	.51	2.72	20.67	39.38
B.	.27	.23	.18	.09	.20	.97	7.37	14.04
C.	.20	1.38	.46	.25	.31	2.60	19.76	37.62
D.	—	—	.01	.05	.01	.07	.53	1.01
E.	.24	.08	.08	—	—	.40	3.04	5.78
F.	—	—	—	—	—	—	—	—
G.	.09	.06	—	—	—	.15	1.14	2.17
Total	1.44	2.44	1.17	.83	1.03	6.91	52.51	100

Table LXXIII.

P7. Variety—"Rochford's Improved Ailsa Craig."

Grade.	Lbs. per Plant.						Tons per Acre.	Per Cent. of Total.
	June.	July.	Aug.	Sept.	Oct.	Total.	Total.	
A.	.52	.69	.47	.35	.52	2.55	19.37	38.05
B.	.21	.26	.15	.07	.23	.92	7.01	13.77
C.	.07	1.38	.44	.14	.31	2.34	17.76	34.88
D.	—	—	.02	.04	.03	.09	.68	1.33
E.	.26	.28	.06	—	—	.60	4.56	8.95
F.	—	—	—	—	—	—	—	—
G.	.10	.09	.01	—	—	.20	1.54	3.02
Total	1.16	2.70	1.15	.60	1.09	6.70	50.92	100

Table LXXIV.

P8. Variety—"Rochford's Improved Ailsa Craig."

Grade.	Lbs. per Plant.						Tons per Acre.	Per Cent. of Total.
	June.	July.	Aug.	Sept.	Oct.	Total.	Total.	
A.	.61	.88	.51	.38	.55	2.93	22.24	46.22
B.	.26	.31	.17	.09	.20	1.03	7.82	16.28
C.	.14	1.04	.28	.17	.28	1.91	14.50	30.11
D.	—	—	.02	.04	.02	.08	.61	1.25
E.	.07	.15	.04	—	—	.26	1.97	4.10
F.	—	—	—	—	—	—	—	—
G.	.06	.07	—	—	—	.13	.99	2.04
Total	1.14	2.45	1.02	.68	1.05	6.34	48.13	100

Table LXXV.

Q1. Variety—"Rochford's Improved Ailsa Craig."

Grade.	Lbs. per Plant.						Tons per Acre	Per Cent. of Total.
	June.	July.	Aug.	Sept.	Oct.	Total.	Total.	
A.	.23	.44	.10	.10	.30	1.17	8.89	24.69
B.	.09	.11	—	.03	.22	.45	3.42	9.49
C.	.05	.42	.11	.09	.23	.90	6.84	18.99
D.	—	—	—	.04	.02	.06	.45	1.27
E.	.23	1.05	.67	.18	.01	2.14	16.27	45.14
F.	—	—	—	—	—	—	—	—
G.	.01	—	.01	—	—	.02	.15	.42
Total	.61	2.02	.89	.44	.78	4.74	36.02	100

Table LXXVI.

Q2. Variety—"Rochford's Improved Ailsa Craig."

Grade.	Lbs. per Plant.						Tons per Acre	Per Cent. of Total.
	June.	July.	Aug.	Sept.	Oct.	Total.	Total.	
A.	.15	.24	.08	.05	.20	.72	5.46	16.51
B.	.09	.05	.04	.02	.18	.38	2.89	8.72
C.	.04	.31	.11	.09	.16	.71	5.40	16.28
D.	—	—	—	.04	.01	.05	.38	1.14
E.	.36	1.12	.70	.16	.01	2.35	17.86	53.91
F.	—	—	—	—	—	—	—	—
G.	.03	.12	—	—	—	.15	1.14	3.44
Total	.67	1.84	.93	.36	.56	4.36	33.13	100

Table LXXVII.

Q3. Variety—"Rochford's Improved Ailsa Craig."

Grade.	Lbs. per Plant.						Tons per Acre.	Per Cent. of Total.
	June.	July.	Aug.	Sept.	Oct.	Total.	Total.	
A.	.22	.35	.07	.07	.22	.93	7.07	22.48
B.	.10	.04	.03	.03	.15	.35	2.66	8.43
C.	.06	.21	.10	.14	.17	.68	5.17	16.43
D.	—	—	—	.03	.01	.04	.30	.97
E.	.41	.96	.51	.13	—	2.01	15.28	48.55
F.	—	—	—	—	—	—	—	—
G.	.04	.09	—	—	—	.13	.97	3.14
Total	.83	1.65	.71	.40	.55	4.14	31.45	100

Q4. and Q5. Fallow.

Table LXXVIII.

Q6. Variety—"Rochford's Improved Ailsa Craig."

Grade.	Lbs. per Plant.						Tons per Acre.	Per Cent. of Total.
	June	July.	Aug.	Sept.	Oct.	Total.	Total.	
A.	.10	.37	.06	.05	.19	.77	5.85	19.06
B.	.07	.03	.01	.01	.13	.25	1.90	6.20
C.	.04	.50	.12	.06	.18	.90	6.84	22.27
D.	—	—	—	.02	.01	.03	.23	.74
E.	.32	.96	.53	.15	.02	1.98	15.05	49.01
F.	—	—	—	—	—	—	—	—
G.	.07	.04	—	—	—	.11	.84	2.72
Total	.60	1.90	.72	.29	.53	4.04	30.71	100

Table LXXIX.

Q7. Variety—"Rochford's Improved Ailsa Craig."

Grade.	Lbs. per Plant.						Tons per Acre.	Per Cent. of Total.
	June.	July.	Aug.	Sept.	Oct.	Total.	Total.	
A.	.11	.27	.05	.10	.14	.67	5.09	17.76
B.	.07	.01	.01	.04	.15	.28	2.13	7.42
C.	.06	.35	.15	.08	.09	.73	5.55	19.35
D.	—	—	.01	.05	.01	.07	.53	1.89
E.	.32	.93	.48	.17	.01	1.91	14.52	50.66
F.	—	—	—	—	—	—	—	—
G.	.03	.08	—	—	—	.11	.84	2.92
Total	.59	1.64	.70	.44	.40	3.77	28.66	100

Table LXXX.

Q8. Variety—"Rochford's Improved Ailsa Craig."

Grade.	Lbs. per Plant.						Tons per Acre.	Per Cent. of Total.
	June.	July.	Aug.	Sept.	Oct.	Total.	Total.	
A.	.17	.30	.15	.09	.23	.94	7.14	21.11
B.	.07	.12	.02	.03	.18	.42	3.19	9.41
C.	.09	.49	.16	.11	.14	.99	7.52	22.19
D.	—	—	—	.04	.01	.05	.38	1.11
E.	.27	1.00	.52	.15	.02	1.96	14.89	43.94
F.	—	—	—	—	—	—	—	—
G.	.02	.08	—	—	—	.10	.76	2.24
Total	.62	1.99	.85	.42	.58	4.46	33.88	100

Manurial Treatment of Series N, O and P.

Base Manure.

1 lb. Lime	} per sq. yd.
14 lbs. Stable Manure	
$\frac{1}{4}$ lb. Bone Meal	
$\frac{1}{4}$ lb. Bone Flour	
$\frac{1}{4}$ lb. Sulphate of Potash	

Top-Dressing.

Mulch of Stable Manure.

Eight dressings, each consisting of 2 ozs. per sq. yd. of the following mixture :—

- 6 parts Meat Meal.
- 8 parts Dissolved Bones.
- 3 parts Sulphate of Potash.
- 2 parts Bone Meal.
- 1 part Sulphate of Ammonia.

This gave 5% Ammonia, 24% Total Phosphates, 12% Soluble Phosphates and 7% Potash on examination.

Cucumber Experiments.

(a) Base Treatment.

As stated in the last Annual Report there is much evidence to show that after the first year of cucumber cultivation some factor exists in the base which has a depressing effect upon the yield and vitality of the crop. As a result, experiments were begun in 1922 with the object of discovering the nature of the depressing factor and its consequent elimination. Two houses were set apart for this inquiry, using half a house for each plot. In one plot the base (which is the soil upon which the beds are placed) was steamed, in two others it was covered with a layer of concrete to keep the roots from entering it, whilst a third was left untreated as a control. The crop yields showed an increase of 35% as the result of steaming the base; neither harm nor good was done by covering the base with concrete.

The base steamed in 1922 was left untouched in 1923 to see if the beneficial effect of steaming would persist in another season; the experiments with beds placed upon the concrete-covered bases were repeated.

A third house was devoted to additional experiments with base treatments. The base of one plot was removed to the depth of eighteen inches, steamed on a trade nursery and replaced. On another plot the base was sterilised with a 2% solution of formaldehyde eight weeks before planting. After digging, 50 gallons of solution were applied to every 12 sq. yds. The saturated soil was covered with sacks during 48 hours, to retain the vapours, and then opened up to allow them to escape.

The results given in Table LXXXII. show that the beneficial effects of steaming obtained in 1922 did not persist in 1923. The yield from D1, where the base was steamed in 1922, and which in that year was 35% greater than the control, in 1923 was practically the same as that from the control plot E2. When, at the end of 1922, the crop from the beds over the concrete was found to be no better than that from the control, it was thought that the beds were too small and that these plots might do better if greater root room was given. Consequently in 1923 the beds over the concrete were made double the normal size, but, as may be seen from Table LXXXII, this had no apparent beneficial result, and the yield approximated to that of the control. The process of removing the base and replacing it after it was steamed proved to be unsatisfactory, as this plot gave a lower crop than the control plot. Treatment of the base with formaldehyde also proved unsatisfactory, although it should be remembered that both this plot and the steamed plot were in the coldest part of the house. The plants on the plot treated with formaldehyde

grew very slowly and the type of growth indicated that some of the formaldehyde had remained in the soil until some time after planting.

Whilst these results show no marked advantage from any of the treatments there are indications of the presence of some factor or group of factors in the cucumber base which has a levelling effect upon widely varied treatments. If this factor be one of active infection it is possible that the low yield of plots D2 and E1 arose through accidental contamination of the beds. Also re-infection would be rapid in the case of the base which was removed, steamed and replaced, and might account for the low yield. The lowness of the yield from the plot treated with formaldehyde may be due to the persistence of this compound in the soil during the spring; at the end of the season the plants in this plot were exceedingly strong and had a better appearance than any others on the nursery.

(b) Top-dressing Experiment.

In House C. an experiment was arranged in which one side of the house was top-dressed with a compost consisting of two parts loam and one part stable manure, whilst the other side was top-dressed with stable manure only. In the latter a small quantity of loam was placed round the neck of each plant to protect it from the manure. The yield from these plots, as shown in Table LXXXII., do not point to one treatment being better than the other.

Table LXXXI.

Showing the composition of the beds, and the top-dressing treatment employed in the cucumber experiments.

House.	Beds.	Top-dressing.	
		1st three dressings March 1st to April 7th.	Remaining dressings April to October 7th.
C1.	2 parts loam 1 part stable manure composted in November.	Stable manure only.	Stable manure with 4 lbs. of fertiliser as given in Tomato Series G. H. & M. to every 100 ft. of border.
C2.	2 parts loam 1 part stable manure composted in November.	Loam and stable manure.	Loam and stable manure with 4 lbs. of fertiliser as given in Tomato Series G. H. & M. to every 100 ft. of border.
D. E. & F.	2 parts loam 1 part stable manure composted in November.	Loam and stable manure.	Loam and stable manure with 4 lbs. of fertilizer as given in Tomato Series G. H. & M. to every 100 ft. of border.

Table LXXXII.

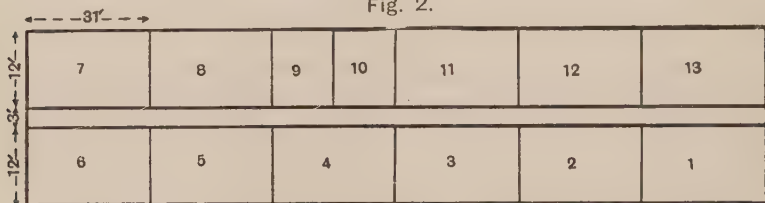
Plot.	Treatment.	Lbs. per Plant.							Total.	Tons per Acre.	Flats per Foot.	Relative Value
		Mar.	April.	May.	June.	July.	Aug.	Sept.				
C1.	Top-dressed with stable manure ...	0.74	12.61	15.47	10.01	8.51	9.22	1.52	58.08	87.70	1.6	103
C2.	Top-dressed with 2 parts loam and 1 part stable manure	0.56	14.50	13.44	10.11	7.48	8.76	1.50	56.35	85.09	1.6	100
D1.	Base steamed in 1922, untreated in 1923	1.17	13.05	10.05	9.53	8.31	9.88	3.50	55.48	83.77	1.6	104
D2.	Base covered with a layer of concrete...	1.48	11.06	9.64	8.94	7.48	8.48	2.77	49.85	75.27	1.4	94
E1.	Base covered with a layer of concrete on which was placed a three-inch layer of ashes	1.34	11.56	10.19	9.63	8.31	9.20	1.96	52.19	78.81	1.5	98
E2.	Control, no base treatment	1.55	12.56	10.55	9.65	7.46	8.38	2.99	53.14	80.24	1.5	100
F1b.	Control	1.83	12.74	9.28	9.31	10.09	10.26	2.53	56.04	84.62	1.6	97
F2b.	Control	1.34	11.32	9.61	12.76	12.29	10.05	2.44	59.81	90.31	1.7	103
F1c.	Base removed, steamed and replaced...	0.93	11.32	10.54	9.94	8.62	8.22	3.03	52.60	79.42	1.5	91
F2c.	Base treated with Formaldehyde at the rate of 1 gallon to 12 sq. yds. ...	0.56	10.09	9.73	8.96	8.01	7.72	3.95	49.02	74.02	1.4	85

Soil Sterilisation Experiments.

Sterilisation experiments in trade nurseries were continued in the same houses and on the same plots as in the four previous years. In the case of Nursery No. 1, where the yield from the untreated plots is low, it will be seen in Tables LXXXIII. and LXXXIV. that consistent benefit has resulted from sterilisation. In Nursery No. 2, in which the yield from the untreated plots is higher than in Nursery No. 1, sterilisation has not materially increased the yield.

Through the kindness of Mr. C. H. Shoults, who placed another of his houses at our disposal, it was possible to arrange a new set of experiments, a plan of which is given in Fig. 2.

Fig. 2.



A house 190 ft. long and 27 ft. wide was divided into thirteen plots, eleven of which were 41 sq. yds., and two 20½ sq. yds. in area. The larger plots contained 166 plants and the smaller 83 of the variety Amwell.

The treatments, methods of application, and yields are given in Table LXXXV. The beneficial result of sterilisation is again evident: carbolic (cresylic) acid, chlordinitrobenzene, dichlorocresol and emulsified heavy oil all produced greater crops.

Table LXXXIII.
Soil Sterilisation Experiments. Nursery No. 1.

TREATMENT.	Plot No.	Total 1919.			1920.			1921.			1922.			1923.			Average lbs. per plant.	Average tons per acre.	Relative.
		Lbs. per plant.	Tons pr acre.	Relative.	Lbs. per plant.	Tons pr acre.	Relative.	Lbs. per plant.	Tons pr acre.	Relative.	Lbs. per plant.	Tons pr acre.	Relative.	Lbs. per plant.	Tons pr acre.	Relative.			
House A.	Steam ...	1	4.29	34.3	114	116	100	4.01	32.1	104	3.98	31.8	124	3.96	31.7	116	4.02	32.1	113
	Steam ...	5	4.44	35.5	118	116	101	4.70	37.6	122	4.30	34.4	134	4.86	38.9	142	4.62	37.0	130
	Carbolic ...	6	4.44	35.5	118	117	102	5.07	40.6	132	4.26	34.1	133	4.80	38.4	140	4.68	37.5	132
	Carbolic ...	8	4.36	34.9	116	117	91	4.43	35.4	115	3.46	27.7	108	4.10	32.8	120	4.04	32.3	113
	Formaldehyde ...	3	4.43	35.4	118	117	103	4.82	38.6	125	4.07	32.6	127	4.48	35.8	131	4.48	35.8	126
	Formaldehyde ...	7	4.44	35.5	116	117	93	4.71	37.7	122	4.20	33.6	131	4.46	35.7	131	4.37	34.9	122
	Untreated ...	2	3.87	31.0	103	100	100	4.02	32.2	104	3.48	27.8	109	3.60	28.8	105	3.74	29.9	105
	Untreated ...	4	3.64	29.1	97	100	97	3.68	29.4	96	2.93	23.4	91	3.24	25.9	95	3.39	27.1	95
House B.	Steam ...	2	4.77	38.2	131	128	118	5.04	40.3	130	5.56	44.5	152	4.38	35.0	131	4.53	36.8	132
	Steam ...	6	4.51	36.1	124	128	114	4.81	39.3	127	5.48	43.8	149	4.79	38.3	143	4.71	37.8	136
	Carbolic ...	5	4.15	33.2	114	114	107	4.38	35.0	113	3.93	31.4	107	4.02	32.1	120	3.90	32.0	115
	Formaldehyde ...	8	4.03	34.2	118	118	100	4.03	32.2	104	4.20	33.6	115	4.05	32.4	121	3.97	32.0	115
	Hot Water ...	4	3.70	29.6	102	109	107	3.99	31.9	103	3.81	30.5	104	3.18	25.4	95	3.46	27.6	99
	Hot Water ...	7	4.18	33.4	115	115	110	4.38	35.0	113	4.33	34.6	108	3.41	27.3	102	3.27	30.2	108
	Untreated ...	1	3.57	28.6	98	100	95	3.92	31.3	101	3.58	28.6	98	3.32	26.5	99	3.43	27.4	98
	Untreated ...	3	3.70	29.6	102	100	105	3.81	30.5	98	3.78	30.0	102	3.38	27.0	101	3.54	28.3	102

**Table LXXXIV.
Soil Sterilisation Experiments. Nursery No. 2.**

TREATMENT.	Plot No.	Total 1919.			1920.			1921.			1922.			1923.			Average lbs. per plant.	Average tons per acre.	Relative.
		Lbs. per plant.	Tons per acre.	Relative.	Lbs. per plant.	Tons per acre.	Relative.	Lbs. per plant.	Tons per acre.	Relative.	Lbs. per plant.	Tons per acre.	Relative.	Lbs. per plant.	Tons per acre.	Relative.			
House A.	Untreated ...	3	5.29	42.3	99	100	103	100	103	100	4.56	36.5	103	4.59	36.7	103	4.23	33.8	98
	Untreated ...	7	5.41	43.3	101	97	97	97	97	97	4.31	34.5	97	4.32	34.6	97	4.37	34.9	102
	Carbolic ...	2	5.16	41.3	96	97	105	104	100	98	4.46	35.7	100	4.53	32.2	90	4.14	33.1	96
	Carbolic ...	6	5.20	41.6	97	102	102	104	95	95	4.20	33.6	95	4.24	33.9	95	4.26	34.1	99
	Steam ...	1	5.39	43.1	101	103	100	114	120	114	5.31	42.5	119	5.32	42.6	119	4.33	34.6	101
	Steam ...	5	5.63	45.0	105	105	93	100	107	107	4.75	38.0	107	4.76	38.1	107	4.23	33.8	98
	Hot Water ...	4	5.76	46.1	108	105	101	109	104	111	4.62	37.0	104	4.62	37.0	104	4.24	33.9	99
	Hot Water ...	8	5.43	43.4	102	105	116	109	117	117	5.20	41.6	117	5.21	41.7	117	4.61	36.9	107
House B.	Untreated ...	1	5.47	43.8	97	100	108	100	105	100	5.03	40.2	106	5.02	40.2	106	4.87	38.9	105
	Untreated ...	5	5.78	46.2	103	103	92	100	95	95	4.52	36.2	95	4.44	35.5	94	4.37	34.9	95
	Carbolic ...	4	5.49	43.9	98	97	95	103	104	105	4.97	39.8	104	4.94	39.5	104	4.27	34.1	92
	Carbolic ...	8	5.37	43.9	96	97	111	103	105	105	5.00	40.0	105	5.04	40.3	107	5.14	41.1	111
	Steam ...	3	5.29	42.3	94	95	86	90	89	95	4.23	33.8	89	4.25	34.0	90	4.09	32.7	89
	Steam ...	7	5.34	42.7	95	95	93	90	100	100	4.78	38.2	100	4.83	38.6	102	4.56	36.5	99
	Hot Water ...	2	5.42	43.4	96	94	107	104	94	94	4.48	35.8	94	4.43	35.4	93	4.33	34.6	94
	Hot Water ...	6	5.12	41.0	91	91	101	104	93	93	4.46	35.7	93	4.47	35.8	95	4.48	35.8	97

Table LXXXV.

Plot.	Area of Plot.	Treatment.	Quantities per Plot.	Method of Application.	Lbs. per plant.	Tons per Acre.	Relative.
1	41 sq. yds.	Untreated ...	—	—	3.86	30.88	101
6	" "	Untreated ...	—	—	3.71	29.68	97
10	" "	Untreated ...	—	—	3.91	31.28	102
3	" "	Carbolic ...	3½ galls.	Diluted to 1 in 40 with water, watered on surface and dug 1 foot deep ...	4.92	39.36	129
4	" "	Chlordinitrobenzene ...	1 lb.	Mixed with ashes, scattered on surface and dug 1 foot deep ...	4.77	38.16	125
9a	20½ "	Dichlororesol ...	2 lbs.	Mixed with ashes, scattered on surface and dug 1 foot deep ...	4.57	36.56	120
9b	" "	Dichlororesol ...	3½ galls.	Mixed with ashes, scattered on surface and dug 1 foot deep ...	4.31	34.48	113
5	41 sq. yds.	Emulsified heavy oil ...	1½ "	Diluted to 1 in 40 with water, watered on surface and dug 1 foot deep ...	4.67	37.36	122
8	" "	Emulsified heavy oil ...	1½ "	Diluted to 1 in 40 with water, watered on surface and dug 1 foot deep ...	4.46	35.68	117
2	" "	Heavy oil ...	1½ "	Mixed with ashes, scattered on surface and dug 1 foot deep ...	4.15	32.20	105
11	" "	Heavy oil ...	3½ "	Mixed with ashes, scattered on surface and dug 1 foot deep ...	4.30	34.40	112
7	" "	Flowers of Sulphur ...	20½ lbs.	Scattered on surface and dug 1 foot deep ...	3.40	27.20	89
12	" "	Formaldehyde ...	3½ galls.	Diluted to 1 in 40 with water, watered on surface and dug 1 foot deep ...	4.36	34.88	114

Mycological Investigations.

During the past year mosaic disease of the cucumber and tomato has been the main problem for investigation. Diseases which have been brought to the Station, and not previously reported are listed below.

HOST.	DISEASE.	PARASITE.
Aster	"Damping off"	<i>Rhizoctonia solani</i>
Carnation	Wilt	<i>Fusarium sp.</i>
Chrysanthemum	Crown Gall	<i>Bacillus tumefaciens</i>
Cucumber	Chlorosis	Cause unknown
Cucumber	Leaf blotch	<i>Cercospora melonis</i>
Heath	Wilt	Fungus not identified
Violet	Leaf mould	<i>Cladosporium sp.</i>

A Root Disease of the Tomato due to "Colletotrichum tabificum."

In the Eighth Annual Report an account was given of a new tomato disease characterised by destruction of the root tissues, accompanied by the presence of minute black sclerotial bodies in the affected regions. The causal organism was isolated, grown in pure culture and named *Sclerotium setosum*, Bewley & Shearn. Some time after the publication of the Report a typical *Colletotrichum* fructification was found on an old culture on cellulose agar and led to further investigation. The appearance of the fungus recalls the published descriptions of *Vermicularia varians*, Ducomet, and *Colletotrichum tabificum* (pro parte Hallier), Pethybridge, but the previous absence of any organised conidial fructification during three years' cultivation in the laboratory seemed to distinguish it as a separate entity. For the sake of comparison the tomato fungus, *Colletotrichum tabificum* and *Vermicularia varians*, were grown on seven different media as indicated in Table I., where the results given indicate a marked degree of similarity between the three fungi. As a further test, healthy tomatoes and potatoes were inoculated by planting in sterilised soil infected with the different fungi. Two months later the roots were examined, and obvious infection was found in the case of those from soils inoculated with all three fungi, while those from the uninoculated pots were perfectly white and healthy. Results given in Table II., coupled with those obtained by the cultivation of all three fungi in various media, lead to the conclusion that the fungi are identical. A detailed account of this investigation will be found in the Annals of Applied Biology, Vol. xi., No. 2; it is concluded that the name *Colletotrichum tabificum* (pro parte Hallier), Pethybridge, should stand.

Table I.

Showing number of sclerotia per sq. cm. of medium after 56 days.

MEDIUM.			<i>Colletotrichum tabificum.</i>	<i>Sclerotium setosum.</i>	<i>Vermicularia varians.</i>
Aesculin Agar	...	...	25	19	26
Amygdalin Agar	...	...	185	156	124
Arbutin Agar	...	...	none	none	none
Casein Agar...	...	...	47	35	72
Ethyl butyrate Agar	...	...	25	34	46
Inulin Agar ...	...	...	91	72	85
Starch Agar...	...	...	52	39	48

Table II.

Plant.	No. used.	Date planted in inoculated soil.	Date examined.	Inoculum.	No. of plants infected.	No. of plants healthy.
Tomato	6	2/10/23	28/11/23	Control	—	6
"	6	"	"	<i>C. tabificum</i>	5	1
"	6	"	"	<i>S. setosum</i>	6	0
"	6	"	"	<i>V. varians</i>	5	1
Potato	6	"	"	Control	—	6
"	6	"	"	<i>C. tabificum</i>	4	2
"	6	"	"	<i>S. setosum</i>	5	1
"	6	"	"	<i>V. varians</i>	4	2

Mosaic Disease of the Tomato.

An account of preliminary studies of this disease was published in the Eighth Annual Report, and five main types of symptoms were discussed. It was suggested that the symptoms recorded were but manifestations of the same

disease, and that their appearance is governed by a number of factors, chief of which are the environmental conditions under which the host plant is grown and the degree of resistance exhibited by it. Further work has indicated that this is the case, but there still appear to be two distinct types of mosaic disease of the tomato. The first and commonest of these is characterised by mottling of the foliage, generally accompanied by distortion of the tissues. The second is similar to the *Aucuba-mosaic* of potatoes, and in this case the yellow blotches appear very suddenly without gradual transition from pale green. They are distinct of outline and deep yellow in colour, like the variegation of *Aucuba Japonica*. The difference between the foliage symptoms of the two forms of mosaic disease is sufficiently marked to enable them to be easily distinguished. But perhaps the most striking difference is that exhibited by the fruit. Fruits from plants suffering from the commonest form of mosaic disease do not differ in external appearance from those on healthy plants, but those from plants showing symptoms of *Aucuba-mosaic* develop a beautiful mottled appearance. Well defined patches of red, alternate with those of deep yellow and silvery white. Occasionally silvery white fruits are found with little or no colour on the surface, and quite frequently the surface is irregular and lumpy. It is obvious that this latter form of mosaic disease is the more serious of the two, because the market value of the fruit is negligible.

The nature of the infectious principle in mosaic disease is obscure, although recent workers favour the idea that it is a living organism. A considerable amount of work has been carried out in connection with this problem at the Station. Minute 'organisms' have been isolated from the filtered virus of tomato mosaic and grown in pure culture. Isolations were made in tubes of tomato extract, containing pieces of living tomato tissue cut aseptically from the interior of healthy green fruits. After inoculation with a loopful of tomato mosaic virus, filtered aseptically through a sterile Doulton candle, the tubes were incubated in the absence of oxygen for two months and then in the air for two months. At the end of this time small brown bodies up to 200 μ in diameter were found adhering to the glass, about one centimetre above the liquid level. These bodies were firmly fixed and not easily detached. They are brittle and break into fragments of a crystalline appearance. When stained with borax-carmines the surface shows concentric and radiating markings. They are cleared by the action of acid, with the evolution of gas, the cleared bodies having a fine granular appearance. Stained by Giemsa's method the bodies resemble bacterial colonies

containing deeply stained purple granules. These granules are 0.3 to 0.4 μ in diameter and appear as cocci, diplococci, polar bodies or unstained rods. These structures are not merely crystals nor detritus but definitely organised bodies growing in colony formation.

Tubes of virus kept in the laboratory under ordinary conditions during six to eighteen months showed similar colonies on the glass where toluene had not been added for preservative purposes or where the toluene had disappeared. Films made from the clear liquid in the tubes bearing the colonies were also stained by Giemsa and showed purple-stained bodies similar to those so abundant in the colonies.

The bodies have been inoculated into healthy plants under various conditions, and while there are indications that they may be causally related to mosaic disease no definite claim can yet be made. A detailed investigation of the character of the "organisms" and their relation to mosaic disease is in progress. A short account of the work already completed is given in "Nature," No. 2825, Vol. cxii., p. 903.

Entomological Investigations.

E. R. SPEYER.

1. Red Spider (*Tetranychus telarius* L.).

Seasonal History.

An attempt was made to ascertain whether Red Spider is able to hibernate in the soil of Cucumber houses. Soil from a badly-infested Cucumber house was placed in a large flower-pot on December 1st, 1922, covered with a glass plate and kept outside, away from any vegetation. On February 19th, 1923, ten Cucumber seedlings from a clean seed-box were planted in this soil in sterilised pots and kept at a temperature ranging from 65°F. to 85°F. No spider appeared on the plants. Though the evidence is negative, we have some reason to believe that the hibernating spider selects dry places rather than damp in which to pass the winter; this would account for soil being avoided for hibernation.

The first attack by spider in propagating houses was noticed shortly after the middle of January; the red adults laid their eggs on the first, second and third leaves of the plants. On plants kept under normal conditions, only a few spider of the first generation reached maturity; these left the plants for another resting period, the attack dying down completely by the middle of February. On some other plants, grown in small pots and watered sparingly, the spider continued to breed into March, when a large majority assumed the red colour and quitted the plants. By the middle of March, however, the attack had died down. Ten days later, a large number of red forms invaded the leaves and development became rapid, at the high temperatures prevailing at the beginning of April. On April 2nd, in a cold frame, hibernating adults were found upon a leafless *Rhododendron*—*Azalea* cross; the next day these wandered on to various leafy plants in the frame, this marking the end of the hibernating period outside.

To give an idea of the proportion of the various stages found on plants at the beginning of the growing season, the following tables of percentage figures are given, eggs being omitted owing to the difficulty of counting:—

Stages.	Feb. 27.	Mar. 2.	Mar. 5.	Mar. 7-10.	Mar. 12.
Larva 1st	35	26	20		10
„ 2nd (Protonymph)...	32	20	21	31	20
„ 3rd (Deutonymph)...	25	24	35		
Adults	8	30	24	69	65

The lower percentage of adults in the last record is due to the adults quitting the plants. During the second outbreak in April, the following records were obtained:—

Stages.	April 4.	April 6.
Larvæ 1st and 2nd ...	43	17
„ 3rd	29	20
Adults	28	63

In this generation the proportion of red adults to summer forms was less than previously and the cessation of activity was not so marked in the middle of April.

On April 20th the main attack began; a continuous series of generations ensued until September, very few red forms

appearing until the webs and "ropes" were constructed at the end of that month. Both red and non-hibernating adults occurred on plants up to the end of November; eggs laid during this month took long to hatch and larval development was slow.

It is noteworthy that, after winter treatment with Cresylic Acid and soft soap, no Red Spider was found in the main cucumber houses at the Experimental Station during the whole season, save in January on some pot-plants. To show the rapidity of spread, it may be stated that the whole of one house in which experiments on spider were carried out in one portion only, became badly infected by mid-summer; from this, the spider spread to an adjoining house, the whole of which was invaded by the end of the season.

Infestation of Tomato Houses.

This is the first season in which Red Spider has occurred in the tomato houses at the Experimental Station. The variety Manx Marvel had been planted for the first time: the attack was general but never reached serious proportions.

On April 3rd the plants in the variety house were examined and the only varieties on which spider was found were Manx Marvel, Kondine Red and a single plant of Tuckswood. The spider was then situated on the sixth or seventh branches from the base of the plant. Later the infestation became general; neither variety nor manurial treatment seemed to influence the attack.

Fumigation Experiments.

With the object of obtaining some fumigant to kill Red Spider on cucumber plants a large number of liquids were tested by the following method.

Vessels 4-litres in capacity were used. A crucible containing 5 cc. of the liquid to be tested was placed on the floor of the vessel and leaves infected with living spider were suspended from the lid. An atmosphere saturated with the fumigant was thus obtained, to which the spider was exposed during a known time. At the end of each exposure the leaves were removed, a representative number (often over 100) of spider in various stages placed on an uninfected plant, and records were taken of the recovery of the spider from the vapours during four days. This latter was a necessary precaution, as, during development, the spiders enter into resting stages at three periods, during which it is not easy to tell whether they are alive or dead.

The following is a list of liquids used, with results :-

LIQUID.	Temp. °F.	Duration of exposure.		Condition of spider.	% of recoveries after 4 days.		
		Minutes.			Young stages.	Adults.	
Ammonia (S.G. 880) ...	70-75	... 100	...	Motionless	... 0	... 0	
Ammonium polysulphide ...	76-77	... 100	...	"	... 0	... 0	
Pyridine	84-87	... 100	...	"	... 0	... 14	
Quinoline	75	... 100	...	Not affected	... —	... —	
Nicotine (Commercial 95%)	70-72	... 100	...	"	... —	... —	
Aniline	69-73	... 100	...	"	... —	... —	
Dimethyl aniline ...	77-88	... 100	...	Motionless	... 100	... 100	
Phenyl-hydrazine ...	66	... 100	...	Not affected	... —	... —	
o-Toluidine	77-87	... 100	...	"	... —	... —	
Carbon bisulphide ...	68-70	... 50	...	Motionless	... 0	... 0	
Carbon tetrachloride ...	67	... 100	...	"	... 0	... 2	
Chlorpicrin	89	... 100	...	"	... 0	... 0	
Tetrachlorethane ...	60	... 100	...	"	... 94	... 100	
Pentachlorethane ...	55	... 75	...	"	... 0	... 100	
Dichlorethylene ...	61	... 75	...	"	... 0	... 0	
Trichlorethylene ...	61-64	... 75	...	"	... 0	... 80	
Perchlorethylene ...	70-72	... 75	...	"	... 0	... 100	
Ethylene dibromide ...	84-86	... 100	...	"	... 0	... 90	
Chlorbenzene	78-79	... 100	...	"	... 0	... 25	
o-Dichlorbenzene ...	78-79	... 100	...	"	... 0	... 20	
o-Chlornitrobenzene ...	67	... 75	...	"	... 100	... 100	
Brombenzene	62	... 100	...	Not affected	... —	... —	
Benzaldehyde	65	... 60	...	Motionless	... 100	... 100	
Benzal chloride	65	... 60	...	Not affected	... —	... —	
Benzyl chloride	62	... 100	...	Motionless	... 100	... 100	
Chlornaphthalene ...	88-93	... 100	...	Not affected	... —	... —	
Amyl alcohol...	87-95	... 100	...	Motionless	... 100	... 100	
Amyl formate	83-86	... 100	...	"	... 0	... 0	
Dimethyl sulphate ...	95-100	... 100	...	"	... 0	... 0	

Some of the experiments were repeated at high and low temperatures, and it was found that at higher temperatures certain substances were more active than at low. For instance, Carbon tetrachloride at 76-78°F. killed only 26% of the spider exposed to the vapours during 75 minutes, while 96% were killed after 50 minutes exposure at 100-102°F. Similarly Dimethyl sulphate had practically no effect at 70°F., whereas 100% were killed at 95-100°F. The more promising compounds were now tried in a 1,000 cubic foot house, the liquid either being poured down the centre pathway or placed in flat glass dishes on the pathway. The fumigations were started at dusk and the ventilators opened at dawn.

Liquid.	Quantity.	Temperature.	Effect.
Ammonia ...	5 ccs. ...	51-76°F. ...	No effect on spider or plants.
„ ...	10 ccs....	55-66°F. ...	No effect on spider, leaves of plants scorched.
Ammonium polysulphide ...	5 fluid ozs. ...	55-62°F. ...	Spider not affected, plants killed.
Pyridine (Commercial 60%-70%)	3 fluid ozs. ...	Min. 64°F....	Spider and plants unaffected, the odour of pyridine persisted in the house for more than a week.
Chlorpicrin...	5 fluid ozs. ...	64-73°F. ...	Plants killed, all spider killed except a few adults.
Carbon tetrachloride ...	10, 20 and 40 fluid ozs. ...	ranging from 66-74°F.	No effect on spider or plants.
Dichlorethylene ...	10 fluid ozs. ...	63-76°F. ...	No effect on spider or plants.
Amyl formate ...	15 fluid ozs. ...	57-75°F. ...	No effect on spider, plants severely scorched.

These results were so disappointing and wasteful of material that two fumigation chambers of 320 and 380 cubic feet capacity respectively were constructed for further trials. In these reduced spaces no better results were obtained by pouring liquids on the ground, whether at night or at high temperature in the daytime. In addition to the compounds mentioned, Allyl isothiocyanate and Tetrahydronaphthalene were given a trial, but both scorched the plants and neither killed spider. Next, various liquids were evaporated over spirit lamps both at night and during the day: when any effect on spider was noticeable the plants were always scorched. It became clear that volatile liquids, especially those with low boiling points, were very unlikely to give any satisfactory results under glasshouse conditions. The effect of the vapours of some volatile solid compounds were now observed in small glass dishes.

Phenol, o-Cresol and Naphthalene were found to kill spider at 17 hours exposure.

As it was late in the season it was decided to concentrate on methods of obtaining a suitable distribution of Naphthalene vapour in a glasshouse. White flake Naphthalene was used, but when merely put in large quantity into a closed chamber

or powdered on to leaves with lime or sulphur there was no appreciable result. Evaporated over a spirit lamp at night the following results were obtained:—

Amount to 1,000 cubic feet.	Effect on Spider.	Effect on Plant.
3/5ths oz.	None	None.
1 $\frac{1}{5}$ oz. ...	Recovery 2 hours after opening house	Some leaves scorched.
2 oz. ...	Recovery 6 hours after opening house	Considerable scorching.

When heated Naphthalene gives off a very irritating vapour, but this is not persistent, and the experiments show that the evaporation was too quick. Experiments were made in glass jars of 3 litre capacity to determine if some liquid could be found which would, on evaporation, take with it the Naphthalene vapours.

Adult spiders were exposed to the vapours given off by one drop of each solvent alone, and a similar drop with Naphthalene dissolved in it, for 16 $\frac{1}{4}$ hours. The temperatures ranged from 59 to 67°F. The weights of liquid used are calculated to equivalent quantities in 1,000 cubic feet space.

Solvents.	Weight. Ozs.	With Naphthalene. Ozs.	Effect on Spider.
Alcohol	4 $\frac{1}{2}$	—	None killed.
„	4 $\frac{1}{2}$	$\frac{1}{5}$	8% killed.
Carbon tetrachloride	5 $\frac{1}{4}$	—	None killed.
„ „	4 $\frac{3}{4}$	$\frac{1}{2}$	10% killed.
Tetrachlorethane	7 $\frac{1}{4}$	—	24% killed.
„	7	—	60% killed.
„	6 $\frac{1}{2}$	$\frac{3}{4}$	100% killed.
„	6	2 $\frac{1}{2}$	50% killed.
o-Dichlorbenzene	8 $\frac{1}{4}$	—	100% killed.
„	6 $\frac{1}{2}$	$\frac{3}{4}$	100% killed.
Cresylic Acid	8 $\frac{1}{2}$	—	16% killed.
„ „	7	$\frac{1}{2}$	44% killed.
Toluene	5 $\frac{1}{4}$	—	Temporary, none killed.
„	5 $\frac{3}{4}$	$\frac{1}{2}$	70% killed.
Xylol	6	—	30% killed.
„	6	$\frac{1}{2}$	16% killed.

The evidence of these experiments was sufficient to warrant a trial on a glasshouse scale, as the figures given indicated that the action of certain solvents in which a comparatively small quantity of Naphthalene was dissolved was increased.

The following amounts of Naphthalene dissolved in Tetrachlorethane were poured down the centre of a 5,000 cubic foot cucumber house:—

Tetrachlorethane.	Naphthalene,	Temperature,	Time taken for spider to recover.
20 fluid ozs.	... 5 ozs.	... 60-80°F.	... 16 hours
40 „	... 10 ozs.	... 60-75°F.	... 39 „
50 „	... 4 ozs.	... 60-80°F.	... 35 „

As all the spider were not killed in any of the trials it was decided to pour mixtures of Naphthalene and Chlor-compounds on the hot pipes. The following are the results:—

Fumigant.	Amount per 1000 cub. ft.	Pipe temp. °F.	Time taken for spider to recover.	Effect on Plant.
Tetrachlorethane ...	8 fluid ozs.	66-98	24 hours.	Leaves scorched.
Tetrachlorethane ...	3 fluid ozs.	88-108	18 „	None.
Tetrachlorethane ...	6½ fluid ozs.	66-88	20 „	None.
Naphthalene ...	½ oz.			
Tetrachlorethane ...	2½ fluid ozs.	78-96	20 „	None.
Naphthalene ...	1¼ ozs.			
Pentachlorethane ...	4¾ fluid ozs.	88-110	No effect	Slight scorching.
Pentachlorethane ...	5¼ fluid ozs.	80-96	Some red forms recover others killed.	Bad scorching.
Naphthalene ...	2 ozs.			
o-Dichlorbenzene ...	6¼ fluid ozs.	Max. 82	Killed.	Severe scorching
Naphthalene ...	1½ ozs.			

From these and a number of other experiments it became clear that Naphthalene vapours are given off too quickly when the Naphthalene is dissolved in a liquid and distributed on the pipes.

In the last experiments of the season white flake Naphthalene was mixed with green sulphur in various proportions and placed on the hot pipes. The results indicate that there was no advantage in adding sulphur. Finally, the maximum amount of solid Naphthalene which could be placed with convenience upon them was distributed on four rows of pipes in a 3,000 cubic feet house. The amount of Naphthalene used worked out at 2 lbs. to each 1,000 cubic feet space.

Only pot-plants were available at the time, and these were placed at various levels, from the ground right up to the ventilators. The pipe temperature ranged from 68°F. to 98°F., that of the atmosphere from 55°F. to 78°F. over a period of four days. At the end of this time there was still a strong and irritating odour of the Naphthalene which had not all volatilised.

The plants were but little scorched and all the spider appeared to be dead. All experiments made late in the season must be regarded with suspicion. It is a matter of the greatest difficulty to tell if red forms of spider are dead or alive, as they will remain entirely motionless during days or weeks and only show movement when placed in some corrosive liquid. On the other hand, when killed with a substance such as Ammonia they will retain their colour and shape during several days at least. With regard to young stages, these were always compared with similar stages on control plants. It is by no means impossible that a vapour should act upon them more easily when their vitality is at a comparatively low ebb, which occurs late in the season.

Summary of Results obtained from Fumigation Experiments.

We have come to the following conclusions regarding fumigation against Red Spider:—

(1) That the action of gases and volatile liquids is ineffective owing to their rapid escape from the atmosphere in glasshouses and owing to the difficulty of keeping up a comparatively high concentration of the vapour sufficiently long to kill the spider.

(2) That Naphthalene, when heated, is the type of fumigant suited to the purpose provided that, within broad limits, the amount of its vapour in the atmosphere can be controlled so that no injury is caused to the plant.

Winter Treatment.

Some preliminary experiments have been carried out to determine if the hibernating red forms are killed by the vapours of Cresylic Acid, Naphthalene or Sulphur dioxide.

To this end, hibernating spider were placed in tins and boxes, small holes or cracks being made in them to imitate crevices in the woodwork of glasshouses. After cleansing a 5,000 cubic feet house with Cresylic Acid and Soft Soap all the spider in the receptacles had not been killed four days after the spraying. The spiders were not killed on an exposed plant placed in the house immediately after the spraying. Similar results were obtained when 20 ounces of Naphthalene were evaporated over spirit lamps. Two pounds of yellow sulphur were burnt in the house at night without any effect on the spider. When burnt on a bright morning, however, all the spider on exposed plants had been killed; the

fumes, however, had not entered the tins and boxes. Thus it would appear that when sulphur is burned in sunlight it is more effective than when used at night. The amount burnt was much less than that usually employed in trade nurseries, and we would recommend that when sulphur is burnt the operation should be carried out in the daytime. With regard to Cresylic Acid it is concluded that the action on spider, which is so effective in winter treatment, is due almost entirely to a contact action which is promoted by the addition of soft soap. This might demand a thoroughness of application which would be difficult to attain on trade nurseries, but it must be remembered that the control of a pest does not demand the immediate destruction of every individual; the great value of the Cresylic Acid and Soft Soap treatment cannot be disputed.

Spraying Experiments.

HOT WATER. It was thought possible that cucumber plants might be treated with water hot enough to kill spider without injuring the foliage. Thermostat experiments gave the following results, the spider on cucumber leaves being immersed in water at various temperatures:—

Temperature °F.		Duration of immersion.	% Spider showing movement after immersion.		% Recoveries after 15 hours.	
142	...	1 second	...	0	...	20
140	...	10 seconds	...	0	...	0
140	...	5 seconds	...	0	...	0
140	...	1 second	...	0	...	15
131	...	10 seconds	...	0	...	84
131	...	5 seconds	...	100	...	100
122	...	10 seconds	...	70	...	97

A pot-plant was now immersed for about three seconds in water at 143°F., a temperature high enough to kill spider during that length of time but one which could hardly be maintained under practical spraying conditions. Both spider and plant were killed outright, and it was concluded that practical results were not to be expected from hot water spraying.

General Sprays.

The following compounds were used as sprays but none was effective:—Pyridine up to 2% strength, Dimethyl sulphate 1%, Colloidal sulphur 0.2%, Potassium sulphocarbonate, Calcium sulphide, Ammonium bicarbonate, Potassium permanganate, Potassium silicate, *α*-Naphthylamine and Hexamine.

A 0.25% solution of Ammonium sulphide with 0.5% washing starch appeared to give promising results, and would be worth a trial next season. A number of sprays sold under trade names were given good trials at the Experimental Station; none proved really economic in its use, whilst some had no effect whatever on the spider.

2. Woodlice (*Oniscoidea*).

Observations upon the habits of the cucumber-house Woodlouse (*Armadillidium speyeri*, Jackson) have been continued.

Considerable numbers were placed in jars and glass dishes containing soil or manure and exposed to frost during November and December. It was found that these Woodlice can survive outside glasshouses during the winter provided that they have a sufficient quantity of loose soil in which to bury themselves.

When soil from a heap, sterilised with Formaldehyde six weeks previously, was brought into the propagating houses great numbers of Woodlice were living in it, and were actually introduced into the seed-boxes at sowing. With a view to obtaining some substance which would kill the Woodlice in heaps of soil left outside during the winter thirty compounds were tested, including Phenols, Cresols, Hydroxybenzenes, Naphthalene and Anthracene, with certain of their derivatives and Camphors, Menthol and Thymol. The Cresols, which largely constitute Cresylic acid, α -Naphthylamine and Naphthalene, all had marked effects on the Woodlice, but for lasting efficiency in the soil, combined with killing capacity and ease of distribution, Phenol was found to be of most value.

(An account of the experiments which led to the choice of Phenol is now in the Press and shortly to be published in the "Annals of Applied Biology"). Phenol in various concentrations in soil was next tested to determine the minimum quantity required for killing Woodlice: 1 part Phenol in

500 parts soil killed all Woodlice introduced up to 9 days after mixing.

750	"	"	"	"	6	"	"
1,000	"	"	"	"	2	"	"
2,000	"	killed no Woodlice.					

The effect of Phenol upon germination of tomato seeds was tested, the compound being mixed dry with 10 lbs. soil in each case, at concentrations of 1 part Phenol in 500 and 750 parts soil respectively. Ten seeds of Ailsa Craig variety were sown in pots in the two soils at varying intervals after mixing.

As a control ten seeds were sown in untreated soil on the sixth day after the experiment was started.

The following Table gives the results obtained:—

A. Phenol 1 part in 500 parts soil.

Number of days after soil treatment that seed was sown	1	5	15	20
Number of days after sowing that plants appeared above soil...	...	...	...	...
Number of days germination was retarded as compared with control	...	...	...	...
Number of plants growing 6 weeks after start	...	...	2	5
			8	8

B. Phenol 1 part in 750 parts soil.

Number of days after soil treatment that seed was sown	1	5	15	20
Number of days after sowing that plants appeared above soil...	...	...	...	...
Number of days germination was retarded as compared with control	...	...	...	...
Number of plants growing 6 weeks after start	...	...	7	9
			9	10

Woodlice introduced into the soils at various times after mixing were killed at both concentrations up to the fifteenth day and after a longer period in A.

Experiments are now being carried out with Commercial Phenol samples, as the pure compound is too expensive for economic use.

A small cucumber house with a 15 ft. run of border was thoroughly sprayed with 12 gallons of 2% Phenol solution at the end of the season. Not all the Woodlice were killed.

Experiments on a small scale showed that a 2.5% solution of Phenol was the weakest which would kill 100% Woodlice within 24 hours.

Phenol solution.	Application.	% Woodlice killed.
4% ...	Woodlice and soil sprayed ...	100 in 1 hour.
4% ...	Soil sprayed and Woodlice introduced ...	100 in 1 hour.
2.5% ...	Soil sprayed and Woodlice introduced ...	100 in 24 hours.
2.5% ...	Woodlice sprayed and placed in fresh soil	2 in 24 hours.
2% ...	Woodlice and soil sprayed ...	50 in 24 hours.

Phenol used as a winter spray in houses would therefore be no more effective than the Cresylic acid—Naphthalene mixture in use, and the cost would be prohibitive.

Tests made with α -Naphthylamine mixed with soil showed this substance to be extremely hurtful to growing plants, though Woodlice and Wireworm were readily killed by it.

Beets and Mangolds as a Trap for Woodlice.

Experiments were carried out in cucumber houses with mangolds, beets, potatoes and carrots with a view to attracting Woodlice from the plants and collecting them in large numbers. Of these red beets and mangolds were by far the most attractive. By cutting them in half, placing the cut surface on the ground between the plants (one half to 4 plants) and collecting the Woodlice in a pail every morning, a very satisfactory control was maintained during the whole season up to August, when the supply of these vegetables gave out and none could be obtained for some weeks.

Poison Baits.

Owing to the very irregular working of the Potassium bichromate and oatmeal bait mentioned in the last Annual Report, experiments were undertaken to improve the bait. Bread and flour were substituted for oatmeal, as a basis, but neither showed an appreciable advantage over the latter. Amyl acetate was substituted for glucose as an attractive agent; the Woodlice responded to this, but appeared to leave the bait untasted after they had been attracted to it.

The proportion of bichromate and glucose was next reduced and the best results were obtained with the following mixture:—

Oatmeal	...	...	...	...	...	50 parts.
Potassium bichromate	...	...	...	...	...	1 part.
Glucose	...	...	...	...	...	2 parts.
Water	...	...	...	...	...	30 parts.

This bait was placed in an isolation house where much damage was resulting to tomato seedlings in October, and also in a small cucumber house. In both cases very satisfactory results were obtained, though in neither were all the Woodlice killed. After one application round the pots no further damage was caused to the tomato seedlings. Close observations showed that a Woodlouse feeding for seven seconds on a bait containing 20% Potassium bichromate died in six minutes; others feeding for two minutes on a dry powdered bait containing 5% bichromate died in from twelve minutes to one hour, but many that fed on the bait were unaffected. The poison is best distributed in the bait in the form of a solution, and the

proportion of glucose should be double that of the bichromate. Sodium fluoride and Paris green used in baits were found to have no effect on Woodlice.

Deterrants.

In order to keep Woodlice from gnawing cucumber stems towards the end of the season from $\frac{1}{2}$ to 3 fluid ozs. of a 6% solution of Commercial Pyridine (40—60% Pyridine) were poured on the soil closely surrounding the plant stems. Nothing under 3 fluid ozs. kept the Woodlice away, and that amount only for a few days.

Fumigation.

While using fumigants for Red Spider it was observed that o-Dichlorobenzene and Tetrachlorethane both affected Woodlice, the former slightly, producing a temporary anæsthesia, the latter more markedly under certain conditions. At first it appeared that some impurity in the Tetrachlorethane was the cause of the Woodlice coming up to the soil surface and lying comatose for some twelve hours, but experiments with several different samples, and with chemically pure Tetrachlorethane, point to the phenomenon possibly being due to temperature conditions, a big fall in the temperature at night perhaps causing a condensation of vapour on the ground surface.

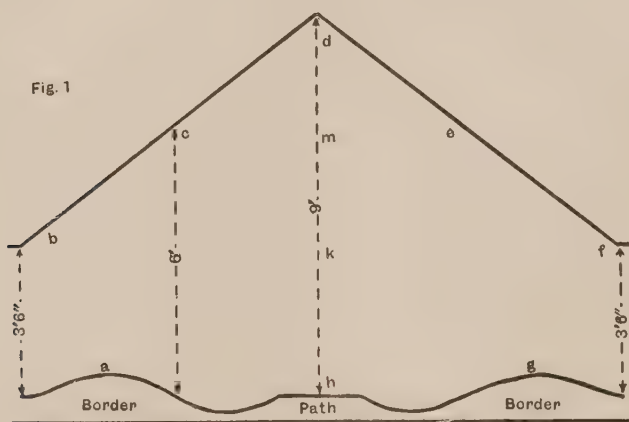
Carbon Dioxide Investigations.

Part I.

OWEN OWEN.

As stated in last year's Report experiments have been carried out to confirm the view that carbon dioxide is not distributed in layers in a glasshouse.

For these experiments cucumber house E., measuring 100 ft. by 14 ft., was used. The other dimensions are shown in Fig. 1. Samples were taken at some, or all, of the positions a to m and analysed. The results of these analyses are shown in Table I.



* Side Elevation of House, showing the points at which samples were taken.

Examination of the figures fails to reveal any suggestion of stratification of the gas. If there was a definite arrangement in layers, then in any series of observations, similarities would be evident for positions b, k, f and c, m, e in Fig. 1. No similarities are found. Indeed, it would appear that the variations are very irregular and the conclusion is that the air in a glasshouse is never still.

The variation in the average value over 24 hours is shown in Fig. 2.

The possibility that stratification might exist under different conditions was also examined. The soil of a small empty chamber of a thousand cubic feet capacity was covered with a layer 6 inches thick, of fresh stable manure. Samples of the air were then taken periodically at heights of 1 ft. 3 ins.,

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3 ft. 6 ins. and 7 ft. 6 ins. above the surface of the manure. It was thought that by this means the carbon dioxide in the air would be increased and any tendency on the part of the gas to stratify would be accentuated. Some dozen sets of observations were made; typical readings are quoted in Table II.

Table I.

Observations made during October, 1923.

Date.	Time.	Position.									
		a.	b.	c.	d.	e.	f.	g.	h.	k.	m.
1923.											
Oct. 11 ...	9.45 a.m. ...	3.4	1.5	—	5.8	10.0	7.6	9.0	3.6	6.5	2.7
"	12.45 p.m. ...	1.1	3.7	1.8	3.7	1.5	—	4.5	3.0	4.4	5.7
"	4 p.m. ...	1.3	3.0	5.4	4.7	2.0	4.6	4.2	5.1	1.8	4.5
Oct. 12 ..	11.30 a.m. ...	1.1	4.2	5.2	4.7	3.6	3.8	7.0	—	3.8	9.4
"	3.30 p.m. ...	—	5.2	6.5	4.4	1.7	1.8	1.9	—	—	—
Oct. 13 ...	9 a.m. ...	7.4	6.7	2.8	5.0	2.0	7.2	9.6	10.0	6.2	—
"	5 p.m. ...	1.5	1.8	2.2	2.2	2.0	3.8	3.8	—	—	—
Oct. 16 ...	9.30 p.m. ...	1.2	5.5	2.4	—	9.5	4.7	5.1	6.3	6.8	6.9
"	12 midnight...	4.0	6.7	10.4	—	2.1	2.2	7.9	3.2	6.1	4.6
Oct. 17 ...	3 a.m. ...	4.3	9.1	7.3	10.5	7.5	8.9	2.0	—	6.3	8.8
"	6 a.m. ...	3.0	5.7	8.8	8.4	3.0	5.1	7.2	16.1	3.4	5.3
"	9.30 p.m. ...	5.1	5.8	4.0	6.3	11.9	4.6	5.3	2.5	3.9	8.0
"	12 midnight...	6.9	4.3	5.4	5.6	7.1	9.6	2.6	6.6	2.5	2.7
Oct. 18 ...	3 a.m. ...	4.4	8.1	4.1	8.8	7.0	—	5.0	9.0	7.7	5.9
"	6 a.m. ...	—	6.7	8.1	8.4	6.2	8.8	5.2	7.1	5.0	7.0
"	9.30 p.m. ...	5.3	4.0	7.0	3.8	3.8	8.0	5.7	5.9	7.8	4.4
"	12 midnight...	2.0	6.6	7.6	5.0	6.0	—	6.9	4.5	4.0	7.7
Oct. 20 ...	3 a.m. ...	5.8	7.9	8.3	5.8	8.4	10.0	6.9	5.4	7.1	—
"	11.15 a.m. ...	3.0	2.7	3.6	4.0	—	—	—	4.6	4.0	5.9
"	2.45 p.m. ...	3.8	2.9	2.5	3.6	—	—	—	2.7	4.0	3.5
"	5.30 p.m. ...	2.0	4.2	5.4	4.6	—	—	—	4.8	4.7	5.7
"	10 p.m. ...	4.9	5.4	4.7	4.4	—	—	—	3.8	—	4.8
Oct. 21 ...	1 a.m. ...	5.5	4.4	—	4.9	—	—	—	5.1	7.4	5.7
"	3 a.m. ...	7.7	7.2	10.2	4.9	—	—	—	6.2	7.7	4.8
"	5.30 a.m. ...	7.7	8.1	11.2	6.2	—	—	—	7.4	8.8	7.1

Table II.

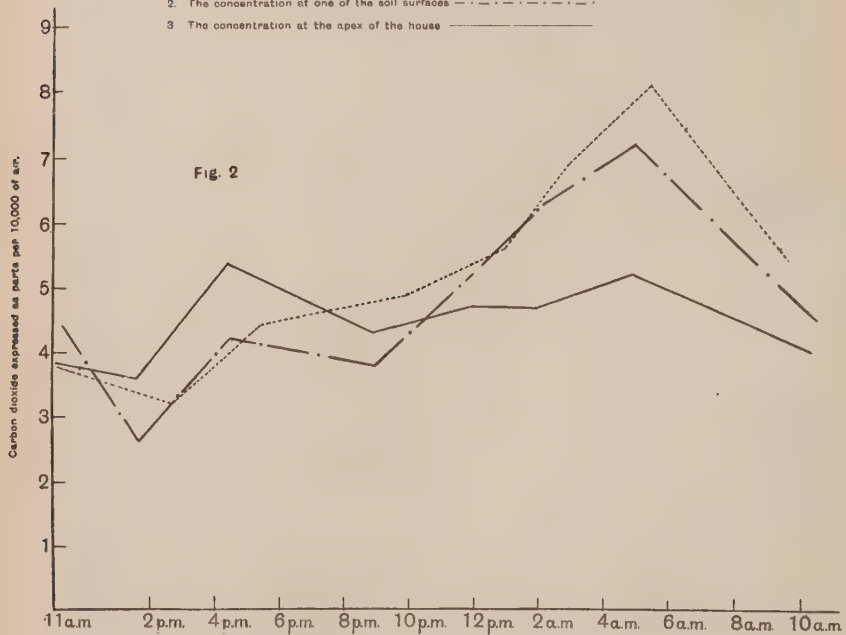
The concentration of carbon dioxide in the atmosphere of an empty house containing only soil and fresh stable manure, capacity approximately 1,000 cubic feet.

Height from soil surface.	Concentration of Carbon dioxide.		
	10 a.m.	1 p.m.	4 p.m.
1 ft. 3 ins. ...	11.7	5.5	3.2
3 ft. 6 ins. ...	15.0	6.1	3.7
5 ft. 6 ins. ...	14.7	4.7	3.5
7 ft. 6 ins. ...	14.2	7.0	4.0

Showing the variation, over 24 hours, in:—

1. The average concentration of carbon dioxide — — — — —
2. The concentration at one of the soil surfaces —
3. The concentration at the apex of the house — — — — —

Fig. 2



Again, it is evident that there is no regular variation at different heights. In case the presence of growing plants might affect the distribution the experiments were repeated in a cucumber chamber of similar dimensions in the presence of the same amount of manure. Typical results are shown in Table III.

Table III.

Height from soil surface.		Concentration of Carbon dioxide.						
		10 a.m.		12 noon.		2 p.m.		4 p.m.
1 ft. 3 ins.	...	4.2	...	2.5	...	2.0	...	1.6
3 ft. 6 ins.	...	3.6	...	2.4	...	2.4	...	1.5
5 ft. 6 ins.	...	3.2	...	2.6	...	2.3	...	2.0
7 ft. 6 ins.	...	3.2	...	2.5	...	2.3	...	2.0

It will be observed that, compared with Table II., the results here shown give lower values for the carbon dioxide. This must be attributed to assimilation, as all these determinations were made in the daytime.

Alternative Methods of Sampling.

It may be argued that the taking of samples could interfere with the samples taken. Some other possibilities were therefore examined. In the first case the small chambers just described were used. The sample bottles were hung on nails fixed at the different heights and left unstoppered for about three hours. During that time the chambers were closed. At the end of the time the bottles were stoppered quickly, taken out and the contents analysed. Again similar results were obtained and are shown in Table IV.

Table IV.

Concentrations shown when sample bottles were left in position for three hours before analysis. Empty house, 1,000 cubic feet capacity, and in which the soil was covered with a six-inch layer of fresh stable manure.

Height from soil surface.	Concentration of Carbon dioxide.					
	10 a.m.		1 p.m.		4 p.m.	
1 ft. 3 ins. ...	6.1	...	5.4	...	5.0	
3 ft. 6 ins. ...	5.7	...	3.9	...	4.6	
5 ft. 6 ins. ...	6.3	...	4.4	...	4.8	
7 ft. 6 ins. ...	6.1	...	5.4	...	4.6	

In the second case an attempt was made to take samples in an ordinary cucumber house in such a way that the observer was a good distance away from the point at which the sample was required. To do this, the use of a system of glass tubing of sufficient length might bring about the desired sampling. To be effective the bore must be small, otherwise displacement of air in sampling would be sufficient to cause an appreciable disturbance. Consequently some ninety feet of capillary tubing were fixed upon suitable supports. The sampling end was open while the other was connected to the tap of a nitrometer. It was intended that mercury from the nitrometer would be forced down the capillary tubing till the latter was full. By altering the level of the mercury it should return and a sample should eventually be drawn into the closed limb of the nitrometer. The transference of the sample to the Haldane apparatus would then be a comparatively easy matter. Actually, in practice the whole procedure was found to be unsatisfactory. In spite of continual adjustments of the capillary tubing, filling it with mercury was invariably a lengthy and tedious process. The taking of a sample, however, was accomplished on very few occasions only. Air bubbles continually made their appearance, and in spite of many adjustments it was impossible to obtain satisfactory samples. After a fortnight this method

was abandoned. In a third case an attempt was made to take a sample from outside the house, by which means a much shorter length of capillary would be necessary. This method was immediately found to be unsatisfactory owing to the appreciable difference in temperature inside and outside a house.

These results afford two conclusions. Firstly, that carbon dioxide is not stratified in glasshouses under ordinary commercial conditions; secondly, that the average concentration varies over twenty-four hours, showing a minimum in the early afternoon and a maximum in the early morning.

Part II.

OWEN OWEN AND P. H. WILLIAMS.

Having determined the amount and distribution in an ordinary house the next step was to devise means whereby the concentration of gas could be increased and controlled as occasion required.

It had already been shown that to introduce the gas into the chamber without circulating the air simply led to a very slight temporary increase in the amount present, and in a short time practically the whole of the gas introduced was apparently lost.

At the beginning of 1923 a mixing fan and suitable driving mechanism was erected near the experimental chamber. The arrangement of the inlet and outlet of the fan is shown in Fig. 3. The capacity of the chamber was 1,000 cubic feet, so that 1 cubic foot of gas introduced corresponded to a concentration of 10

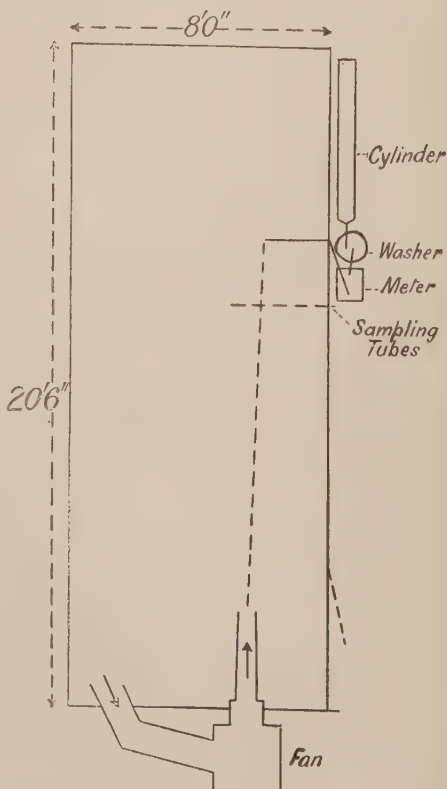
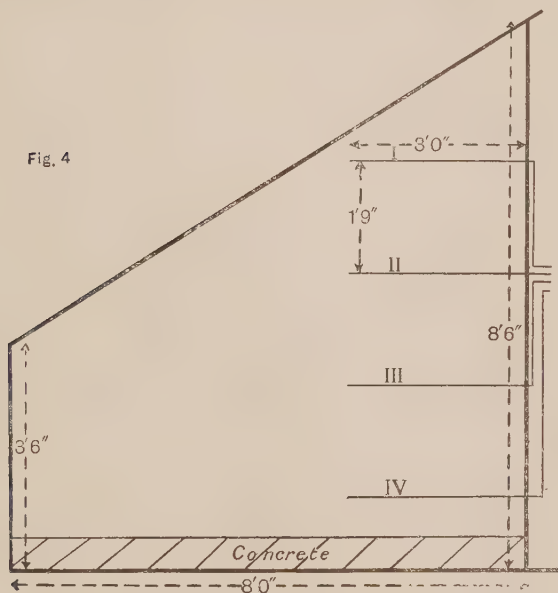


Fig 3

Plan of Chamber, showing Fan, etc.

parts per 10,000. Carbon dioxide obtained from a cylinder was allowed to flow into the house and the fan was kept running. While this took place samples were taken from outside the house by means of the sample tubes shown in Fig. 4.



Side Elevation of Chamber showing sampling Tubes (not to scale).

Under these conditions the distribution was found to be good but there was a serious loss of carbon dioxide, in spite of the fact that every possible precaution to prevent leakage had been taken. Thus at two places in the house 10.7 and 11.0 parts per 10,000 were the respective concentrations. Actually, about three times this amount had been introduced. The carbon dioxide was in this case conveyed into the inlet of the fan. When, however, the gas was liberated in front of the outlet of the fan about half the theoretical concentration was found, as is shown in Table V. The numerals refer to the sampling tubes shown in Fig. 4.

Table V.

Theoretically 25.0 parts Carbon dioxide per 10,000.

Found:—I.	...	...	...	14.2 parts.
II.	...	...	...	14.2 „
III.	...	...	...	13.9 „
IV.	...	...	...	13.7 „

Owing to the freezing of the washing apparatus and meter it was found impossible to introduce more than three cubic feet of gas per hour into the chamber, so that the concentrations obtained by this method were necessarily low. To obtain a large volume of gas in a short time sodium bicarbonate was decomposed with oil of vitriol. A vessel containing the necessary amount of bicarbonate was placed in front of the outlet of the fan and oil of vitriol run into it by sampling tube III. One-and-a-half pounds of bicarbonate were used, and this should have given a concentration of 64.2 parts carbon dioxide per 10,000 parts of air. Carbon dioxide was also passed in from the cylinder. The total concentration expected was 73.5 parts. By analysis only 38.1 parts were found to be present. The distribution was perfect. Using four-and-a-half pounds of bicarbonate, giving a theoretical concentration of 192.6 parts, 173 were found. Thus a greater proportion of the carbon dioxide could be accounted for. The increase in the amount of gas found present in this case is probably to be associated with the fact that although three times as much bicarbonate was used it was decomposed in about twice the time: that is, three times as much gas was generated in twice the time.

Throughout these experiments trouble had been experienced from the frothing of the mixture of acid and bicarbonate, which made the operation comparatively slow. Using less impure acid, the frothing was much reduced, and the time taken to decompose the bicarbonate reduced considerably. Under these conditions 193 parts were found instead of a theoretical 197. Similar results were obtained with smaller amounts of bicarbonate.

Having found a satisfactory method of producing a given concentration of carbon dioxide in a chamber the next step was to devise a means of maintaining that concentration. At low concentrations it was sufficient to introduce the gas from the cylinder after the initial concentration had been obtained from bicarbonate. An example of the results using this procedure is given in Table VI.

Table VI.

Bicarbonate just decomposed	...	33.7 parts	Carbon dioxide.
After 50 minutes	...	32.5	" "
After 1 hour 35 minutes	...	30.3	" "
After 2 hours 10 minutes	...	29.9	" "

The method was open to a serious objection—it involved continuous mixing by means of a fan. This was impracticable in the experiments with plants to be carried out later in the season.

An alternative method was therefore sought. The rate at which the carbon dioxide was lost was determined. It was found to be constant at any given concentration of the gas. Hence it was possible at the end of a given time to introduce a sufficient volume of gas to bring the concentration to its initial value. The concentration in the chamber could be regarded as the mean of the two extremes. Tests showed that the rate of loss was unaffected by stopping the fan as soon as the bicarbonate was decomposed. Thus, while carrying out large scale experiments with plants, it was possible to put the required amount of carbon dioxide into one chamber and then proceed to treat a second and a third in turn. Tables VII. and VIII. show the similarity in the rate of loss with the fan running all day and with it stopped.

Table VII.
Fan running all day.

Theoretically 64.2 parts carbon dioxide per 10,000.

Bicarbonate just decomposed	...	...	25.5 parts.
After 1 hour ...	...	...	11.7 "
After 2½ hours	...	...	5.7 "
" 4 "	...	...	4.7 "
" 5½ "	...	...	3.6 "
" 6½ "	...	...	3.2 "

Table VIII.
Fan stopped after decomposition of bicarbonate.

Theoretically 73.5 parts carbon dioxide per 10,000.

Bicarbonate just decomposed	...	...	38.1 parts.
After 1 hour ...	...	...	23.2 "
After 2 hours	...	...	15.4 "
" 3 "	...	...	10.4 "
" 4 "	...	...	7.7 "
" 5 "	...	...	6.1 "
" 6 "	...	...	5.7 "
" 7 "	...	...	5.1 "

The possible effect of the soil on the carbon dioxide had previously been eliminated by covering the floor of the chamber with a six-inch layer of concrete. This was now covered with undried virgin soil to a depth of four inches. The addition of soil had no effect on the rate of loss, although the humidity was much increased,

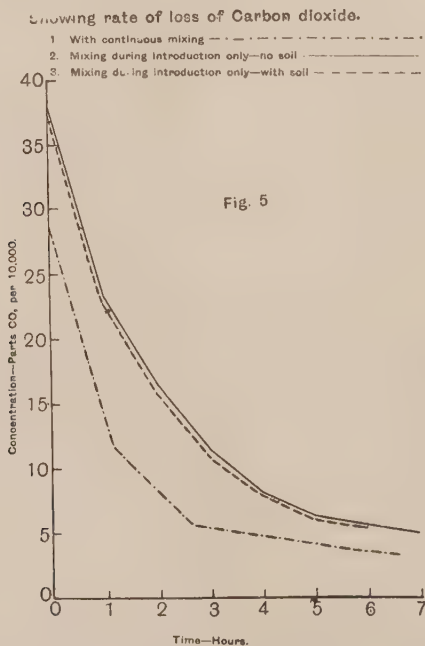
Table IX.
Soil in chamber.

Theoretically 71.5 parts carbon dioxide per 10,000.

Bicarbonate just decomposed	...	...	37.1 parts.
After 1 hour ...	...	...	21.6 "
After 2 hours	...	...	13.9 "
" 3 "	...	...	9.1 "
" 4 "	...	...	7.1 "
" 5 "	...	...	5.8 "
" 6 "	...	...	5.8 "

The figures given in Tables VII., VIII. and IX. are embodied in Fig. 5.

The method outlined above was applied to the experiments with plants carried out in the partitioned house constructed this year. Fig. 5 shows the arrangement of the inlet and



outlet pipes of the fan and the nature of the treatment given. The troughs containing the bicarbonate were placed in front of the pipes and acid was run in through tubes passing through the wall of the house.

The distribution of the carbon dioxide was perfect as is shown in Table X.

Table X.**Distribution of carbon dioxide in different chambers.**

Samples at 5 feet above ground in three stations across chambers.

X2.—A.	...	...	119.1	parts per 10,000.
B.	...	...	119.1	" "
C.	...	...	118.5	" "
X3.—A.	...	...	84.7	" "
B.	...	...	84.7	" "
C.	...	...	84.9	" "
X5.—A.	...	...	40.9	" "
B.	...	...	45.1	" "
C.	...	...	43.6	" "

The following concentrations were used in the various chambers:—

X2.	30 × Normal—Initial concentration	...	120	parts.
	Falling to	...	60	"
	Average	...	90	"
X3.	20 × Normal—Initial concentration	...	80	"
	Falling to	...	40	"
	Average	...	60	"
X5.	10 × Normal—Initial concentration	...	50	"
	Falling to	...	10	"
	Average	...	30	"

The actual values found varied around these figures. Table XI. gives the results of typical analyses.

Table XI.

Carbon dioxide actually found in different chambers.

X2.	Initial concentration	...	119.2	parts per 10,000.
	After 40 minutes	...	64.5	" "
	After 2nd dose	...	113.4	" "
X3.	Initial concentration	...	80.8	" "
	After 40 minutes	...	43.7	" "
	After 2nd dose	...	75.1	" "
X5.	Initial concentration	...	43.2	" "
	After 40 minutes	...	15.8	" "
	After 2nd dose	...	46.7	" "

The experiments with plants were designed to test the effect of various concentrations of carbon dioxide on crop yield. Two of the six chambers were used as controls and three received different amounts of carbon dioxide.

Into the remaining chamber the gas was passed continuously through perforated pipes laid on the soil beneath a mulch of dung.

This experiment was designed to test the suggestion of certain workers that the chief value of stable manure lies in the carbon dioxide liberated during its decomposition in the soil. The relative positions of the chambers is shown in Fig. 6. Seventy tomato plants (variety "Rochford's Improved Ailsa Craig") were grown in each chamber.

The method by which the various concentrations were maintained has been already described. Treatment was given on all fine mornings and commenced between 8.0 and 8.30 a.m. The concentration was kept up during approximately two hours. On dull or wet mornings no gas was used, but if the weather improved carbon dioxide was introduced in the afternoon.

The chambers were closed while carbon dioxide was being introduced but otherwise received the ordinary cultural treatment. In chamber X6. the carbon dioxide was washed and measured and passed into perforated pipes which ran along the surface of the soil between the rows of plants. A total of 326.65 cubic feet of gas was passed in between June 20th and October 29th, equivalent to 2.45 cubic feet per day. The chamber otherwise received the same treatment as the remainder.

Investigations on the composition of the atmosphere in X6. showed that the constant supply of carbon dioxide did not cause differences of concentration at different levels. Analyses over complete periods of 24 hours were not carried out, but enough evidence was obtained to show that the conclusions arrived at in the case of cucumber houses also hold good in tomato houses. The results obtained are summarised in Table XII.

Table XII.
Summary of Results.

House.	Nature of treatment.	Lbs. per plant.	Tons per acre.
X1. Control		4.40	33.44
X4. Control		5.14	38.96
Average of controls		4.77	36.20
X2. 30 × Normal (90 parts per 10,000)	...	5.03	38.23
X3. 20 × Normal (60	„ „) ...	4.92	37.40
X5. 10 × Normal (30	„ „) ...	5.42	41.19
X6. Continuous evolution of gas from soil surface		5.94	45.14

The yields were low; only in two cases were they over 40 tons to the acre. This is probably due to the lateness of planting and to the temperatures on the chambers. The

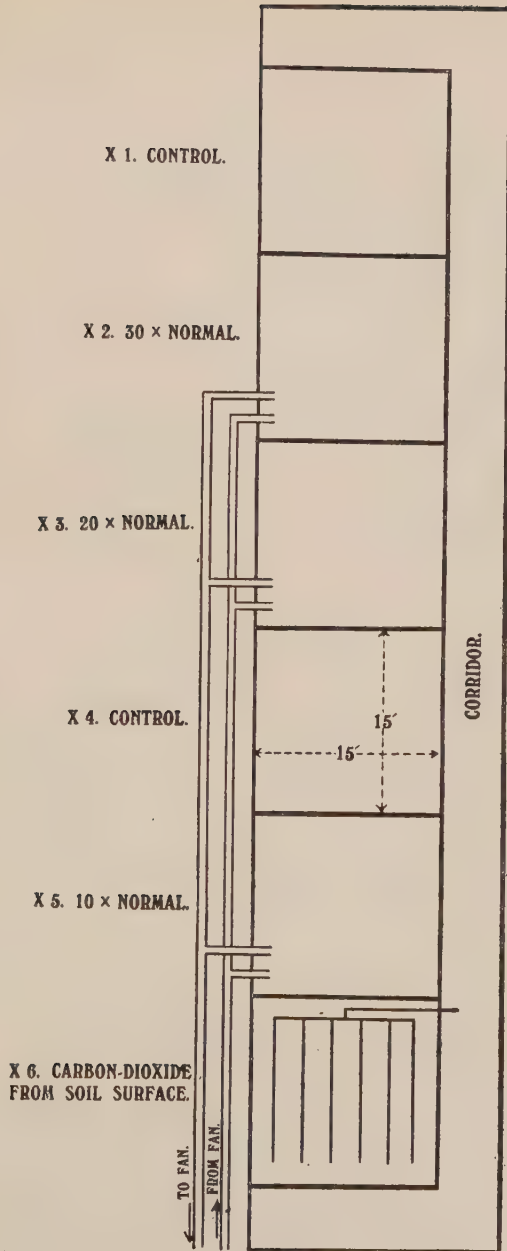


Fig. 6.

completion of the house was unavoidably delayed and hence the plants remained in pots five weeks after the other houses had been planted.

The temperature in the chambers nearer the boiler was very high, especially at the beginning of the season. As a result very little fruit set, whilst the plants grew luxuriantly. There was a gradual fall in temperature, as the distance from the boilers increased, and this was accompanied by a gradual decrease in the height of the plants. The crop, on the other hand, increased as the temperature decreased.

At the end of the season the roots were examined for disease. Analyses of the soils in the chambers are also in progress and the results of the determinations so far made are included in the following Table:—

Chamber.	Percentage Healthy Roots.	Percentage Diseased Roots.	Percentage Calcium Carbonate.	Percentage Organic Matter.
X1.	87	13	.17	8.43
X2.	32	68	.26	8.46
X3.	74	26	.12	8.57
X4.	86	14	.06	8.36
X5.	68	32	.12	8.65
X6.	50	50	.12	9.91

The above figures show that, compared with most tomato soils, the soils are deficient in calcium carbonate. It appears, further, that some relation exists between the carbon dioxide introduced and the state of the roots. Whilst the percentages of diseased roots in the untreated chambers (X1. and X4) are 13 and 14 respectively, the percentage in the treated chambers varies from 26 to 68. These figures are of interest in view of Lundegarth's recent work in which he found that certain species of *Fusarium* are favoured by excess of carbon dioxide in the air. A further investigation of this question is in progress at the Station.

Chemical Investigations.

OWEN OWEN.

During the year one hundred and thirty soil samples have been examined for various constituents. Of these, considerably more than half have been taken from plots in the Station houses. The samples from commercial nurseries have, generally speaking, been analysed for carbonates. From the results it would appear that considerable variations exist in single nurseries in respect of this particular constituent.

For instance, in one nursery, the age of the houses and consequently the treatment given, caused variations. The total carbonates (expressed as calcium carbonate) lie between the wide limits of 0.1% and 3.8%. Even in one block of the same age, growing the same variety and with the same treatment throughout, the limits were 0.1% and 0.2%. In no case was there an exceptional crop.

In another nursery a house which had recently been steamed showed 5.3%. A few samples taken in new houses of commercial nurseries show such soils to be deficient in organic matter and carbonates.

Samples of the soil in the new block of houses at the Station were taken from each of the thirty-two plots before any cultural operations had taken place. The only noteworthy result is that with two exceptions none of the plots showed the presence of carbonates—the two exceptions, and in these two the amounts were so low as to be almost insignificant. Generally speaking, the potash, phosphate and nitrogen were lower in this block than in the old block. Typical results are shown in the following Tables, in which are reproduced the results of analyses carried out at the Rothamsted Experimental Station of samples taken in 1914.

Mechanical Analysis.

						Virgin Soil in New Block. 1923.	Virgin Soil in Old Block. 1914.
Fine Gravel	...	...	...	...	...	6.7	3.5
Coarse Sand	...	...	...	...	...	26.2	24.4
Fine Sand	...	...	...	...	...	22.0	22.4
Silt	...	...	...	...	...	16.8	19.6
Fine Silt II.)	...	...	...	...	...	3.4	11.1
Fine Silt I.)	...	...	...	...	...	3.6	
Clay	...	...	...	...	...	6.5	4.7
Loss on Solution	...	...	...	...	...	5.0	4.6
Loss on Ignition	...	...	...	...	...	9.92	8.58

Chemical Analysis.

Nitrogen	...	...	...	...	...	.18	.32
Potash ($K_2 O$)	...	...	...	...	...	.26	.33
„ (available)*	...	...	...	...	...	.015	.018
Phosphoric Acid (PO_5)	...	...	...	...	...	.26	.32
„ „ (available)*	...	...	...	...	...	.06	.08
Total carbonates as Calcium Carbonate	...	...	...	...	...	—	—

* Soluble in 1% Citric Acid.

All figures are given in percentages on air-dried samples.

Meteorological Records, 1923.

Month.	Rain.		Average outside Temperatures.		Bright Sunshine.
	Total fall. 5 inch Funnel Gauge.	No. of Rainy Days.	Day Maxm. °F.	Night Minm. °F.	Daily average in hours.
	Inches.				
January	1.36	14	46.6	34.9	1.78
February	3.50	21	46.9	37.5	1.48
March	2.11	19	50.1	37.4	2.56
April	1.51	13	54.0	39.3	4.11
May	1.68	16	58.8	33.4	5.40
June	0.69	9	62.4	37.6	4.00
July	2.87	12	75.1	56.3	7.72
August	1.99	11	70.8	52.2	8.42
September	1.79	13	64.8	46.7	6.17
October... ..	4.64	21	56.5	45.1	3.07
November	1.42	11	43.6	32.0	2.82
December	2.11	19	43.2	32.5	1.13
Total or Mean...	25.67	179	56.1	40.4	4.05

Dates of Cultural Operations during 1922—1923.

Crop.	Sown.	Potted into 60's.	Potted into 32's.	Planted out in borders.	First Mulching.	First Top Dressing.	First Fruit Picking.	Last Fruit Picking.
Tomatoes ...	Dec. 18, 1922.	Jan. 26, 1923.	—	G.H.J.K. Feb. 28. M.N.O.P.Q Mar. 19.	May 8	May 24	May 28	Oct. 12
Cucumbers ...	Dec. 18, 1922.	Dec. 27, 1922.	Jan. 17, 1923.	Feb. 6	—	Mar. 1	Mar. 21	Sept. 21

